May 1974
Volume 18
Number 3

Mariners Weather Log

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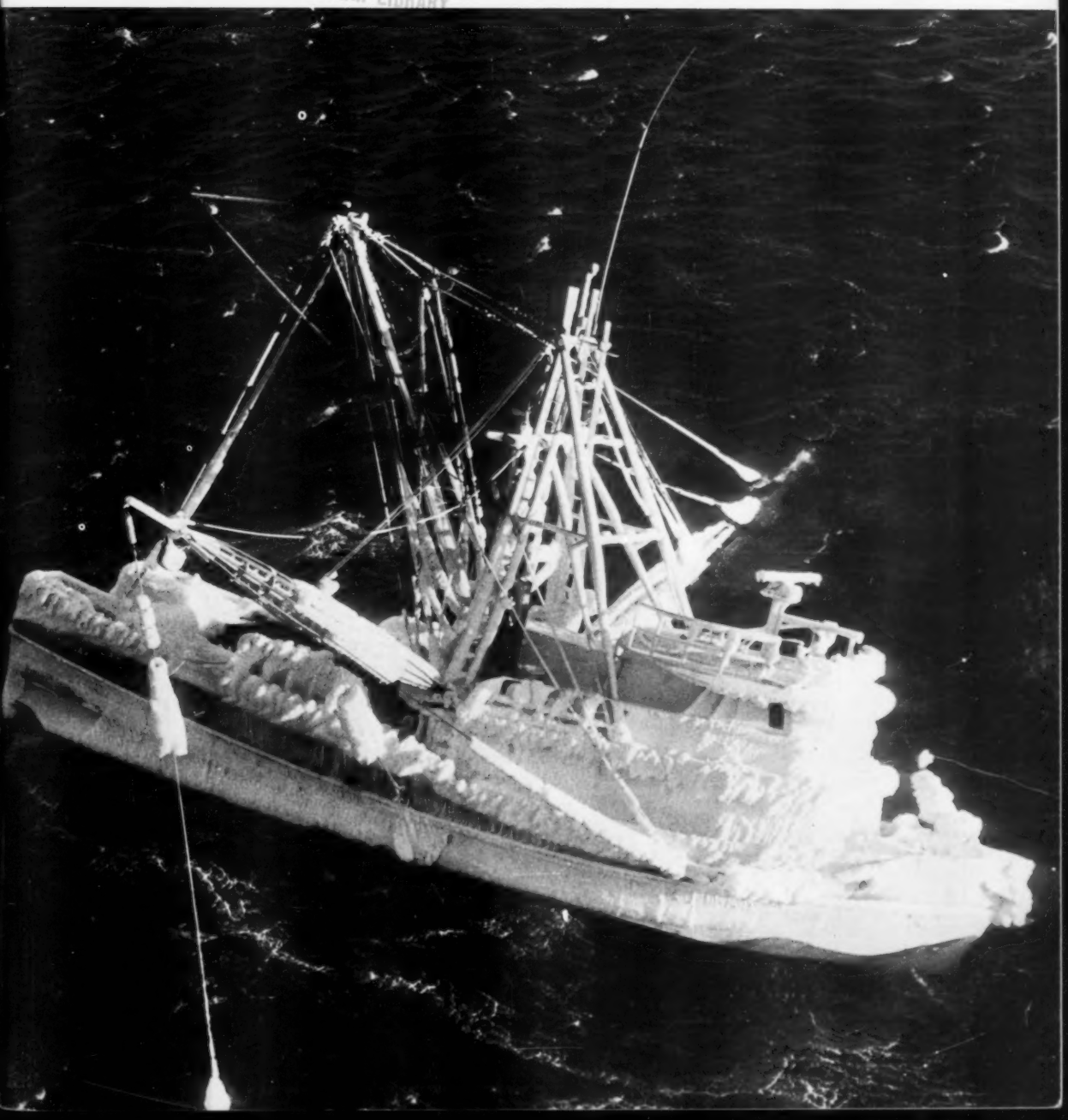

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Mariners Weather Log

Editor: Elwyn E. Wilson

Editorial Assistant: Nancy L. Westrell

May 1974
Volume 18 Number 3
Washington, D.C.

Cover: The dramatic ice build-up on the fishing vessel JOHN AND OLAF presents a stark contrast to the surrounding seas. Though striking, the results were deadly. Four persons perished in the icy waters of the Gulf of Alaska after they abandoned the vessel. See page 170 for details. U.S. Coast Guard Photo.

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Routing
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The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical approved by the Director of the Office of Management and Budget, July 26, 1973.

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MARINERS WEATHER Log

CAPE ROLLERS- UNUSUALLY HIGH SWELLS OFF THE SOUTH AFRICAN COAST

Robert G. Quayle
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Asheville, N.C.

The area to the southeast of the Cape of Good Hope has generated considerable interest in recent years because of the increased traffic resulting from the closing of Suez and the use of tankers too big for the canal. It is an area of particular interest to weather-watchers because it combines relatively low wind speeds with substantial waves. By definition, most of the highest waves observed in this region are swell, that is, waves which have traveled beyond their source region. These large swell waves have been descriptively called "cape rollers" by some seamen who frequent the route. There have been verifiable observations of strong breezes (winds 22 to 27 kt), fair skies, good visibility, and significant swell heights of over 40 ft. Significant waves represent the average height of the highest one-third of all waves visually observed. There may be extreme waves present, and their height may equal as much as 1.8 times the significant wave height (Thom, 1971).

Unlike its sister cape, the "Horn" (about 55°S), the Cape of Good Hope (about 35°S) has relatively settled weather. Since gale and rainy weather frequencies around South Africa are only about one-third the amounts around the Horn and far less intense (U. S. Navy, 1958), the Cape of Good Hope is given much less notoriety. Indeed, weather related to maritime disasters off South Africa are rare, but are becoming more common with increasing traffic. One of the worst in recent years was the sinking of the tanker WORLD GLORY (48,823 tons) in 1968, about 90 mi off the Durban coast. She broke in two and plunged to a fiery grave during heavy weather, with a considerable loss of life. Surviving crewmen estimated the waves to be 70 ft high. The SAUDI (5,973 tons) was capsized by huge waves off the Horn of Africa in June 1973. In August 1973, the FIDELITY (12,107 tons) buckled a forward plate in high seas in the same general area.

The January-February 1974 issue of Sea Secrets related two earlier occurrences that involved deep troughs. The 750-ft EDINBURGH CASTLE was steaming into a heavy southwesterly swell without difficulty in August 1964. The waves were about 150 ft long. Suddenly, as the ship was lifted by a wave, which appeared to be about 300 ft long, she charged downward at an angle of 30° into a hole in the ocean. Before the ship could lift again, the next wave was shoveled aboard as solid water to a height of 15 to 20 ft, and athwart ship rails and a ladder were carried away. A second case involved the British cruiser BIRMINGHAM during World War II. While steaming comfortably in a moderate sea and swell, the ship suddenly and without warning hit a hole, and the next sea broke over two turrets and the open bridge, 60 ft above the waterline. In both cases, it is possible that the hole was caused by the coincidence of the troughs of a number of different wave trains.

Marsden Square 441 (30°-40°S, 20°-30°E) was chosen for analysis (fig. 1). Tabulations for this area were originally produced by the National Climatic

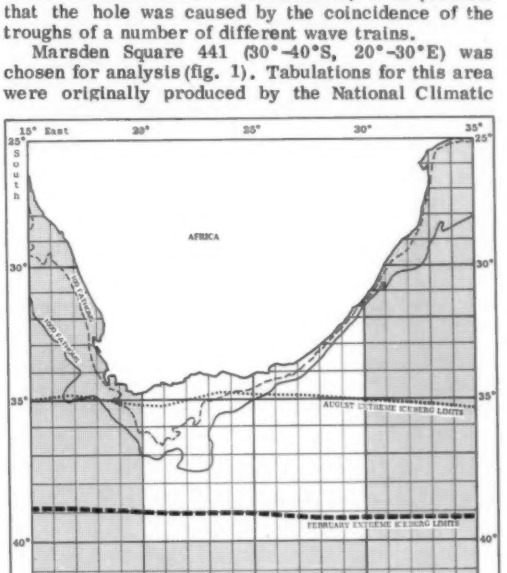
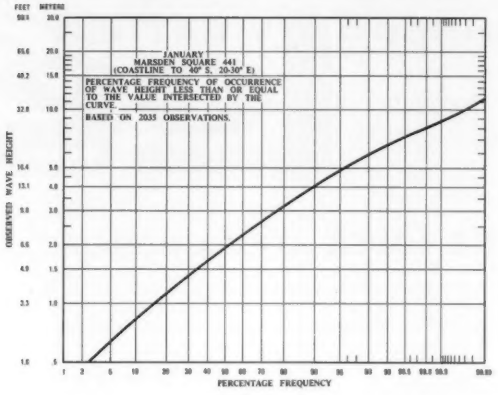
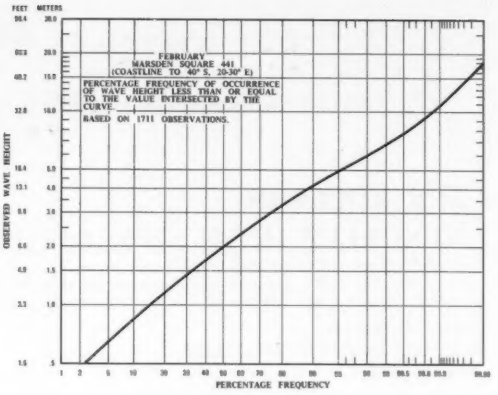
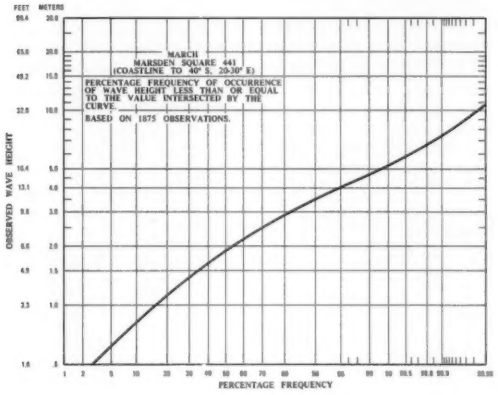
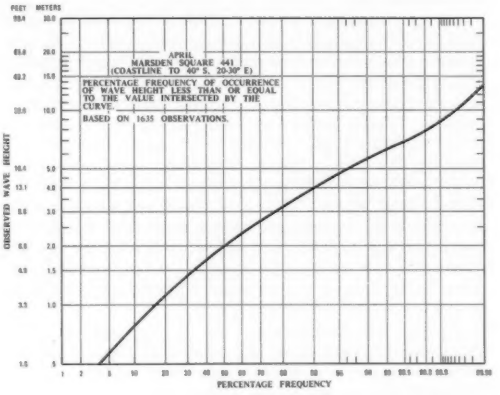


Figure 1.--Coast of South Africa. The sea area in white is the region for which the wave observations were summarized in this study.


FEET METERS
JANUARY
MARSDEN SQUARE 441
(COASTLINE TO 40° S, 20-30° E)
PERCENTAGE FREQUENCY OF OCCURRENCE OF WAVE HEIGHT LESS THAN OR EQUAL TO THE VALUE INTERSECTED BY THE CURVE.
BASED ON 2035 OBSERVATIONS.
OBSERVED WAVE HEIGHT
PERCENTAGE FREQUENCY


FEET METERS
FEBRUARY
MARSDEN SQUARE 441
(COASTLINE TO 40° S, 20-30° E)
PERCENTAGE FREQUENCY OF OCCURRENCE OF WAVE HEIGHT LESS THAN OR EQUAL TO THE VALUE INTERSECTED BY THE CURVE.
BASED ON 1711 OBSERVATIONS.
OBSERVED WAVE HEIGHT
PERCENTAGE FREQUENCY


FEET METERS
MARCH
MARSDEN SQUARE 441
(COASTLINE TO 40° S, 20-30° E)
PERCENTAGE FREQUENCY OF OCCURRENCE OF WAVE HEIGHT LESS THAN OR EQUAL TO THE VALUE INTERSECTED BY THE CURVE.
BASED ON 1875 OBSERVATIONS.
OBSERVED WAVE HEIGHT
PERCENTAGE FREQUENCY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APRIL
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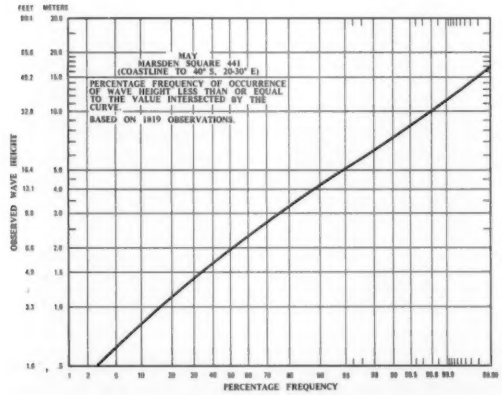
PERCENTAGE FREQUENCY OF OCCURRENCE OF WAVE HEIGHT LESS THAN OR EQUAL TO THE VALUE INTERSECTED BY THE CURVE.
BASED ON 1635 OBSERVATIONS.
OBSERVED WAVE HEIGHT
PERCENTAGE FREQUENCY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MAY
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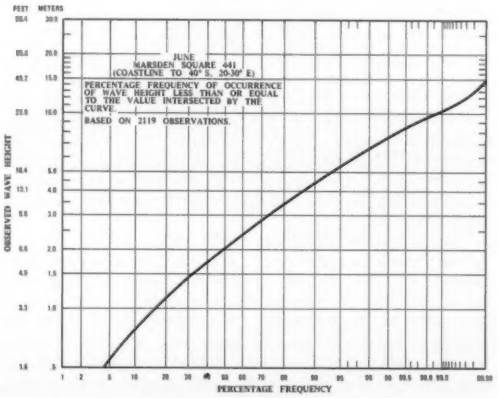
(COASTLINE TO 40° S, 20-30° E)
PERCENTAGE FREQUENCY OF OCCURRENCE OF WAVE HEIGHT LESS THAN OR EQUAL TO THE VALUE INTERSECTED BY THE CURVE.
BASED ON 1819 OBSERVATIONS.
OBSERVED WAVE HEIGHT
PERCENTAGE FREQUENCY


FEET METERS
JUNE
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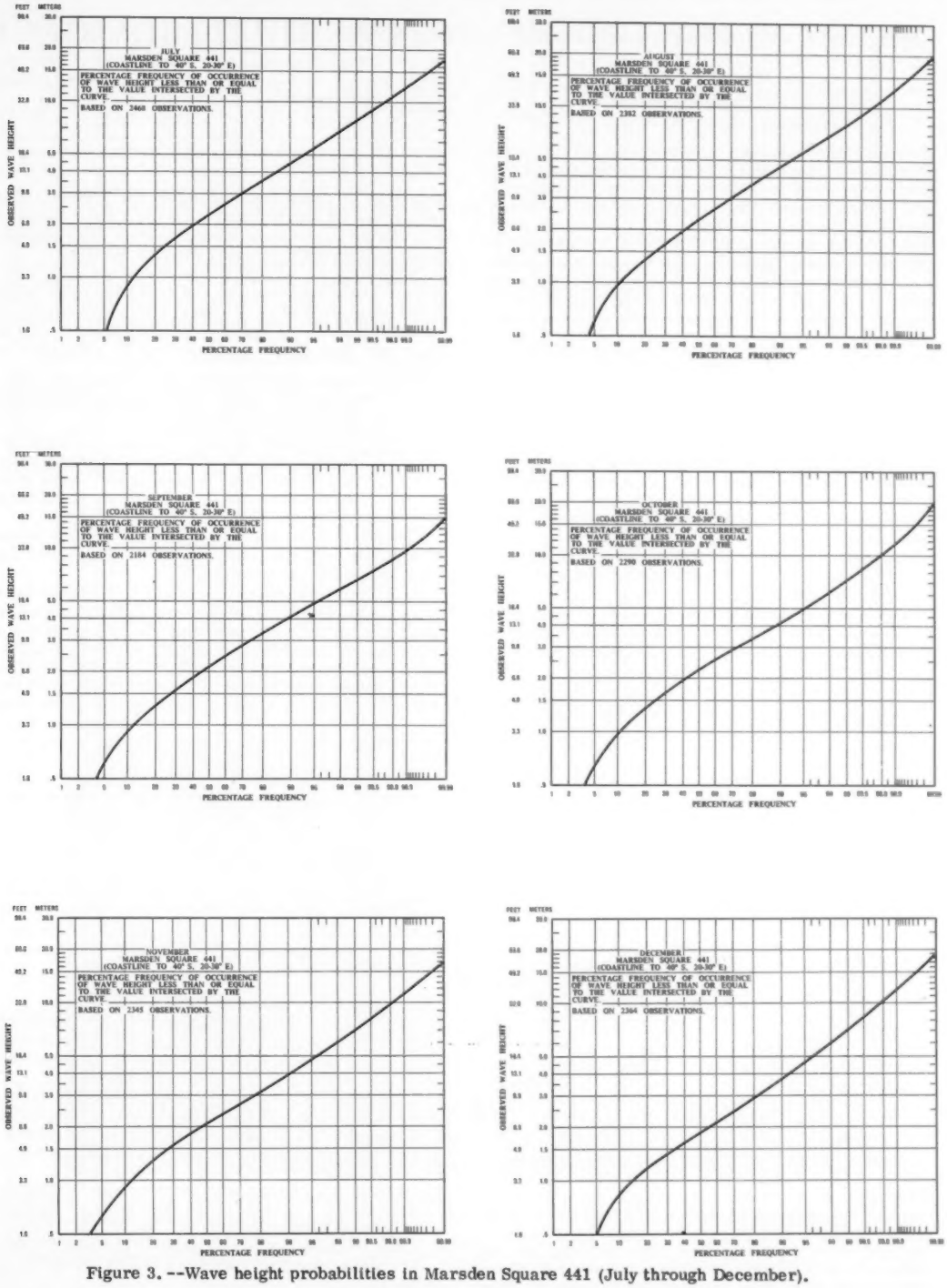
PERCENTAGE FREQUENCY OF OCCURRENCE OF WAVE HEIGHT LESS THAN OR EQUAL TO THE VALUE INTERSECTED BY THE CURVE.
BASED ON 2119 OBSERVATIONS.
OBSERVED WAVE HEIGHT
PERCENTAGE FREQUENCY

Figure 2. --Wave height probabilities in Marsden Square 441 (January through June).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BASED ON 2345 OBSERVATIONS.
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BASED ON 2364 OBSERVATIONS.
OBSERVED WAVE HEIGHT
PERCENTAGE FREQUENCY

Figure 3.--Wave height probabilities in Marsden Square 441 (July through December).

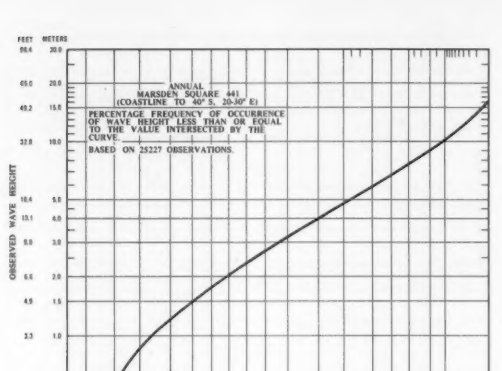
FEET METERS
ANNUAL
MARSDEN SQUARE 441
(COASTLINE TO 40° S, 20-30° E)
PERCENTAGE FREQUENCY OF OCCURRENCE OF WAVE HEIGHT LESS THAN OR EQUAL TO THE VALUE INTERSECTED BY THE CURVE.
BASED ON 25227 OBSERVATIONS.
OBSERVED WAVE HEIGHT
PERCENTAGE FREQUENCY

Figure 4.--Wave height probabilities in Marsden Square 441 (Annual).

Center in 1972, for the Webb Institute of Naval Architecture. The data were collected during the period 1949-71. Though data for the entire area were combined, most observations (about 90 percent) were taken within a narrow strip extending less than 100 mi off the coast. Figures 2 through 4 show monthly and annual empirical wave height probabilities plotted on logarithmic probability paper. Data were scrupulously quality-checked before being summarized for inclusion in the graphs. When questionable data were encountered, their reasonableness was assessed by use of synoptic considerations (Pierson et al., 1955). Since many early observation sources did not distinguish between sea or swell, the highest wave train reported was used for summary purposes. This has proven to be a relatively good system, since many mariners find it difficult to distinguish between sea and swell when making an observation, though they can generally make a fairly good estimate of overall wave conditions.

By use of quasi-objective methods developed by Thom (1971) and Fulbright (1973), estimated return periods for significant and extreme (1.8 x significant) wave heights were computed for Marsden Square 441 and are given in table 1.

Table 1.--Wave height return values

Years	Significant Height (ft)	Extreme Height (ft)
5	56	100
10	61	109
25	67	121
50	73	131
100	79	142

This shows that, on the average, a significant wave height of 61 ft will be reached or exceeded once every 10 yr.

It is not possible to find a good climatic analogy for the Cape of Good Hope in the Northern Hemisphere because circulation and land mass patterns are so different. Nevertheless, a few oceanic areas of similar latitude have been summarized in table 2. The

Table 2.--Percentage frequency of observations of waves with gentle breeze or calmer, and gales

Area	Gentle breeze or calmer (Winds ≤ 10 kt with wave reports)	Gales (Winds ≥ 34 kt with wave reports)	Waves ≥ 8 ft	≥ 13 ft	≥ 17 ft	≥ 23 ft
M.S. 441 (30°-40°S, 20°-30°E)	43.0	3.0	42.7	18.5	4.7	1.1
Bermuda (30°-34°S, 63°-67°W)	40.4	3.0	18.4	7.1	1.9	0.8
Tokyo (34°-37°N, 139°-142°E)	33.4	4.6	20.1	7.0	1.3	0.3
Azores (36°-40°N, 24°-32°W)	34.7	6.0	29.9	12.3	2.9	0.9

selection of areas was limited to the availability of tabulations at the National Climatic Center--mostly Summaries of Synoptic Meteorological Observations produced for the U.S. Naval Weather Service.

Inspection of table 2 shows that while calm conditions are more frequent and gale conditions rarer in the Marsden Square 441 area, high waves are much more prevalent. It should be pointed out here that at least two factors are contributing to sabotage our results:

1. Fair weather bias results in lower average winds and waves because ships in passage tend to avoid bad weather.
2. Only observations with wind and wave reports were used. Since observers frequently fail to code wave observations if wave conditions are calm, this reduces the percentage of reported fair weather conditions.

Though it is somewhat difficult to quantify these factors, we can hope they are operating in about the same manner at all locations.

A study of the general circulation of this area offers some insight into its wind and wave patterns. During the summer, the area lies near the center of a col between two semipermanent oceanic subtropical highs. In winter the col moves equatorward and the area comes under the influence of the westerlies, with the mean position of a trough just downwind of the area (U. S. Navy, 1958). Thus, the most intense portions of storm systems imbedded in the westerlies will usually move to the south of the area. The swells generated by such systems will move into the area relatively unimpeded. Occasional reinforcement (the uniting of wave trains from differing sources) plays a part in the building of some of the waves.

The principal conclusion one can draw is that the wave systems of the South African coast offer substantially different problems than those of the Northern Hemisphere. Though the results are not completely unexpected, considering the tremendous fetches offered by the Southern Hemisphere, the magnitude of the differences is significant.

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A SATELLITE-DERIVED EXPERIMENTAL GULF STREAM ANALYSIS

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Hillcrest Heights, Md.

Despite years of intensive investigation, the scale, location, and frequency of Gulf Stream meanders are shrouded in uncertainty. Normal ship data collection methods fail to provide an adequate density of coordinated synoptic data for such determinations. Since the launch of the NOAA-2 environmental satellite on October 15, 1972, oceanographers have been able to monitor sequentially, and in fine detail, the complex surface thermal patterns associated with such rapidly changing features as the Gulf Stream, slope water, and shelf water circulations.

Under relatively cloud-free conditions, the Very High Resolution Radiometer (VHRR) aboard NOAA-2, which has a spatial resolution of 1 km at nadir, provides detailed thermal information about the underlying radiative surfaces. The VHRR system gathers data in both the visible and infrared channels. The visible channel, 0.6-0.7 μm (micrometers wavelength), measures the reflected solar radiation from the earth, while the infrared channel operates both day and night to measure the radiation emitted from the earth's surface in the 10.5-12.5 μm wavelength region. The orbiting motion of the satellite (near-polar and sun-synchronous at an altitude of 1,460 km), together with the day-night operation of the VHRR scanner, provides thorough coverage of North America and the adjacent ocean areas out to 1,000 km or more from shore twice daily at approximately 0900 and 2100 hr local time. The direct readout capability of this instrument, when the satellite is within range of the NOAA command and data acquisition ground stations at Wallops Island, Va., Fairbanks, Alaska, and San Francisco, Calif., enables immediate use of the data.

The information content of the gray-scale images (fig. 5) is extracted to produce a chart which displays several significant ocean surface thermal

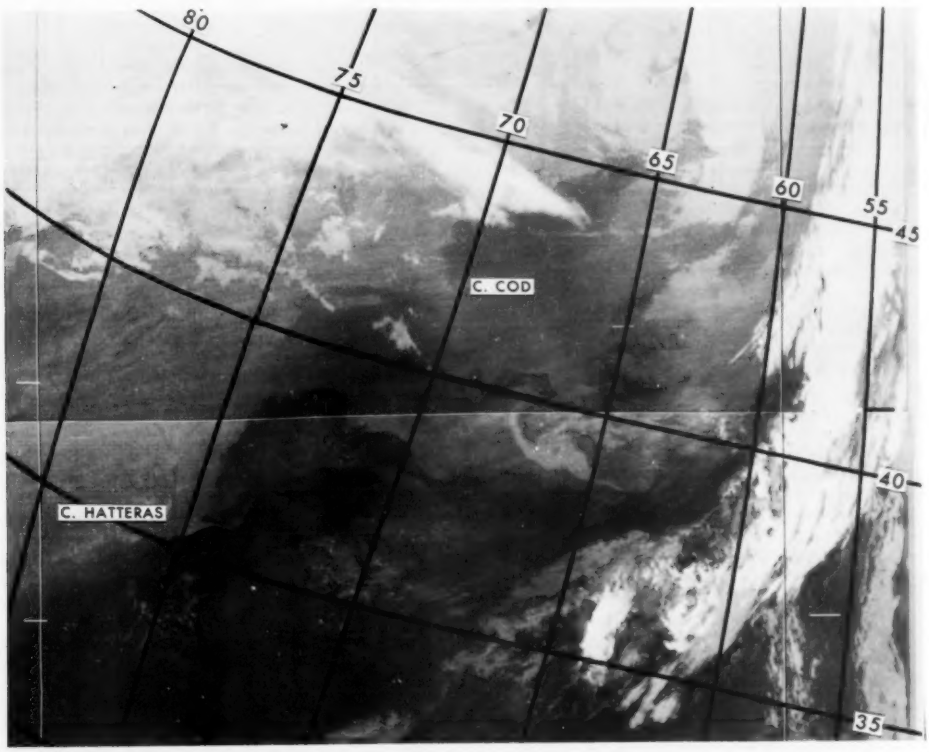

Figure 5.--NOAA-2 Very High Resolution Radiometer infrared image acquired January 22, 1974. The display is arranged so that the relatively cold clouds are shown as light areas (less radiant energy reaching the radiometer), warmer regions are shown as darker areas (more energy reaching the radiometer). (For analysis, refer to figure 6.)

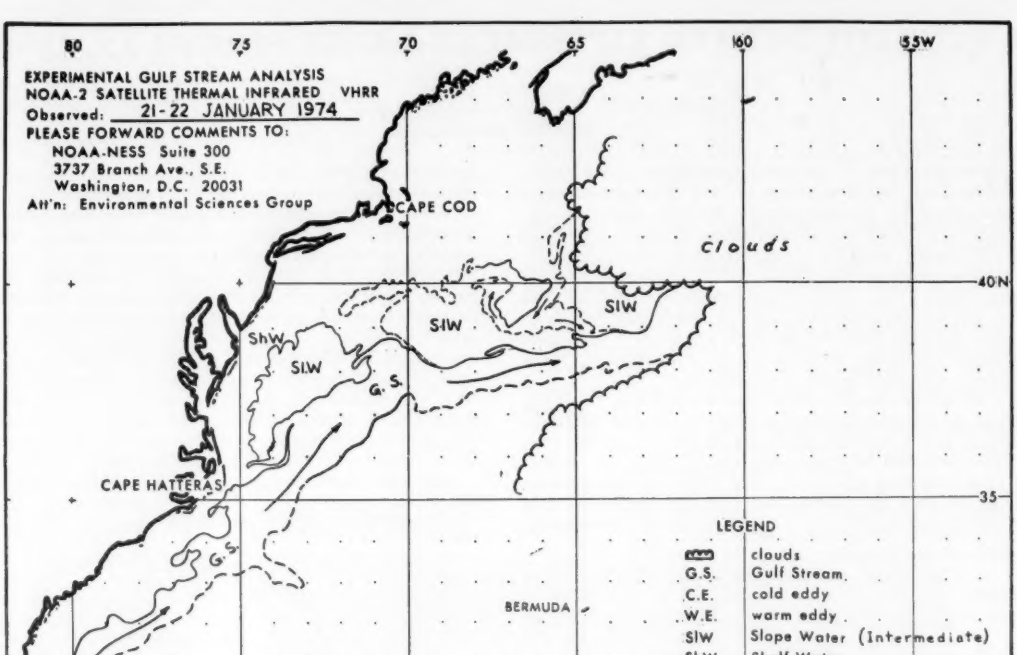

Figure 6.--Experimental Gulf Stream analysis facsimile chart for January 21-22, 1974. Note the filament of cool shelf water near 36°N, 74°W. In the vicinity of 39°N, 66°W, is an intrusion of cold, southward-flowing Labrador Current water.

features (figs. 6-8). Major water masses, fronts (thermal gradients), currents, and eddies are identified and located. The charts provide sequential synoptic information about the ocean surface only when relatively cloud-free conditions exist. Changes can be analyzed at weekly, monthly, or seasonal intervals, or they can be evaluated in terms of particular meteorological phenomena, such as storm-induced effects. In order to provide wide and rapid distribution of this information, the satellite-derived chart is transmitted weekly, at 1240 on Thursdays, via the National Weather Service facsimile circuit.

In most cases the charts have represented composites of images acquired over periods of several days; in this way, the obscuring effects of transitory cloud cover are minimized. The direction of flow of surface currents is indicated on the charts wherever the direction of flow can be interpreted from the imagery. It is not possible to infer current direction from the imagery unless there are distinct temperature differences between adjacent water masses or within a single water mass.

The first Experimental Gulf Stream Analysis facsimile chart was transmitted June 20, 1973. Only monthly transmission was possible during the summer because of extensive cloud cover and poor thermal contrast between the ocean features under investigation. Near-weekly charts have been constructed, beginning with October 1973, as the thermal contrast between the Gulf Stream and the surrounding water masses increased and persistent cloud cover diminished.

On a weekly basis, even minor surface changes in the Gulf Stream system are obvious: meanders develop and expand; filaments of warmer and cooler water form, lengthen and break off, and then dissipate into another water mass. Small lateral movements of oceanic fronts are perceptible when such thermal boundaries are sharply defined. Warm anticyclonic eddies have been observed to form from isolated northward meanders in the vicinity of 40°N, 67°W (figs. 7 and 8). Subsequently, they move westward through the slope water toward Cape Hatteras as they moderate and are finally re-absorbed by the Gulf Stream off the Cape (fig. 8). This pattern confirms the life cycle of these eddies as described by previous researchers. A cold-core cyclonic eddy was observed on August 27, 1973, and, although such eddies are known to travel a southwesterly path along the western edge of the Sargasso Sea, seaward of the Gulf Stream, none have been observed to do so since production of the charts began.

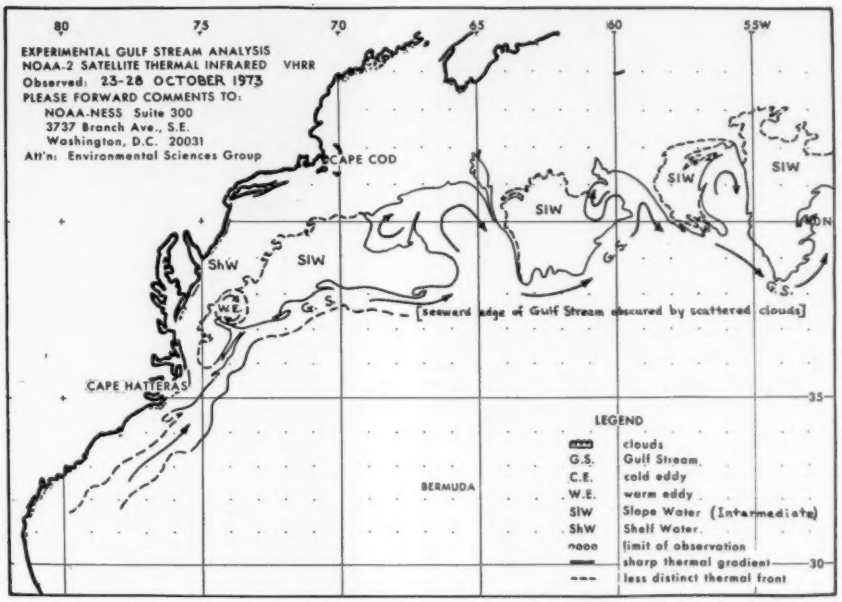

Figure 7.--Facsimile chart for October 23-28, 1973. The warm eddy northeast of Cape Hatteras (37.5°N, 74°W) was first observed forming in July at 39°30'N, 69°30'W; it has traveled through the slope water for 3 mo to this position. Note the series of pronounced meanders east of 70°W.

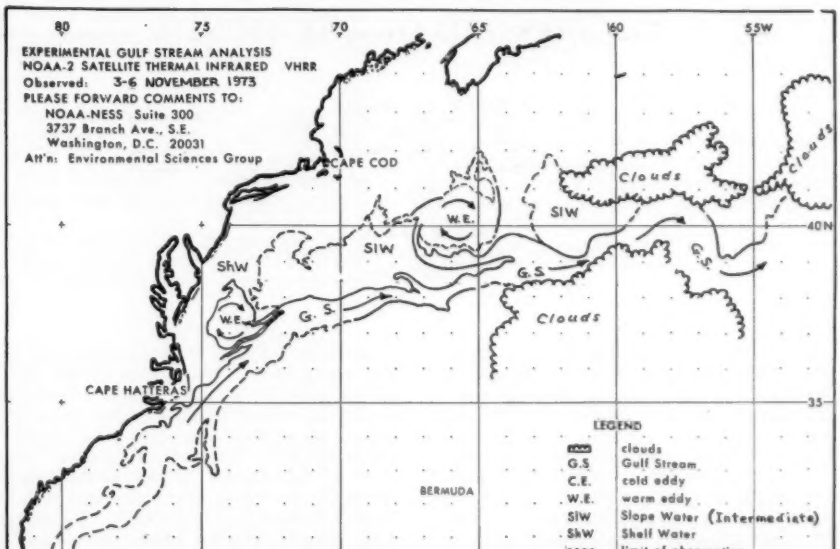

Figure 8.--Facsimile chart for November 3-6, 1973. The warm eddy (37°N, 74°W) has remained in essentially the same position for 1 wk as it is destined to become absorbed by the Gulf Stream northeast of Cape Hatteras. The cool intrusion moderated very quickly after this analysis. The pronounced meander shown in figure 3, near 40°N, 65°W, continues to develop into a warm, anticyclonic eddy centered at 40°N, 66°W.

Difficulties arise in the analysis and interpretation of the imagery when thermal boundaries between water masses are diffuse or indistinct, or when there is extensive fog or cloud cover over the western North Atlantic Ocean. The latter problem is particularly troublesome on nighttime IR imagery, when the area is covered by patchy fog. It is difficult to differentiate between the thermal patterns associated with the cloud or fog-covered areas and those associated with ocean surface features, with no simultaneous visible imagery for comparison.

VHRR data can be digitized, and, by using the appropriate calibration curves and atmospheric attenuation corrections, actual surface temperatures can be obtained. To date, this has been done only in a few limited cases for research purposes.

Response to the Experimental Gulf Stream Analysis has been quite favorable from both Federal and private groups engaged in marine activities. Plans are now being formulated for making this satellite-derived Gulf Stream analysis a routine product of NOAA's National Environmental Satellite Service.

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INFRARED AND VISIBLE IMAGERY OF THE ATLANTIC OFF THE EAST COAST OF THE UNITED STATES FOLLOWING THE MARCH, 1973 MONSTER OF THE MONTH

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Figures 9 and 10 show the eastern Atlantic Ocean and the east coast of the United States as seen by the thermal-infrared and the visible channels of the NOAA-2 Very High Resolution Radiometer (VHRR) on March 25, 1973.

The two images demonstrate the different information that is available from the satellite sensor's two channels. The visible picture (fig. 9) shows the earth as it would have looked to a human observer in space. The infrared image (fig. 10), on the other hand, is not a photograph in the ordinary sense of the word, but rather, a gray-tone depiction of the daytime temperatures of the earth's land, water, and cloud tops. The darker portions of the infrared picture represent higher temperatures; the light portions, lower temperatures. The lightest portions are the cold tops of high clouds. The relatively warm land appears darker than the coastal waters. In the ocean, the warm (dark) North Wall of the Gulf Stream is shown interfacing in a series of eddies, with the southward-extending cold (light) Slope Waters. Although some eddy structure is a normal feature of the North Wall, the confused, almost "torn" appearance of the middle section of the interface is undoubtedly the result of the churning action of a storm (named "Monster of the Month" in Mariners Weather Log, Vol. 17, No. 3), which had passed through the region 2 days earlier. This storm was responsible for sinking two Norwegian vessels off the eastern U. S. seaboard. The edge of the storm can be seen as a white swirl of clouds on the right hand side of both pictures.

An interesting feature of the pictures is the sea ice that is apparent in the visible, but not the infrared,

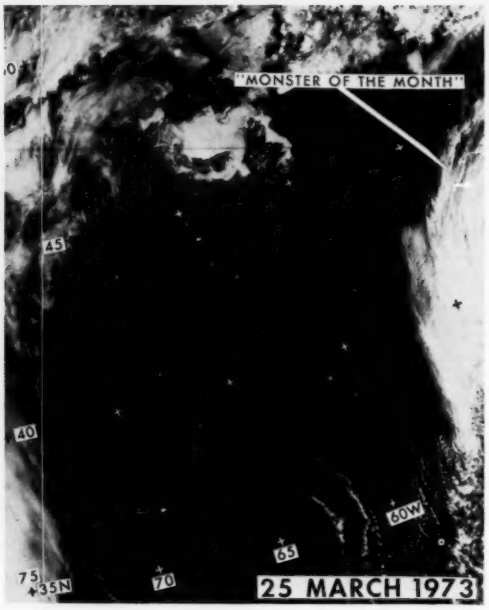

Figure 9. --Visible image taken by NOAA-2 does not show the intricate details of the Gulf Stream as does the infrared picture (fig. 10). However, the ice in the Gulf of St. Lawrence shows up much clearer.

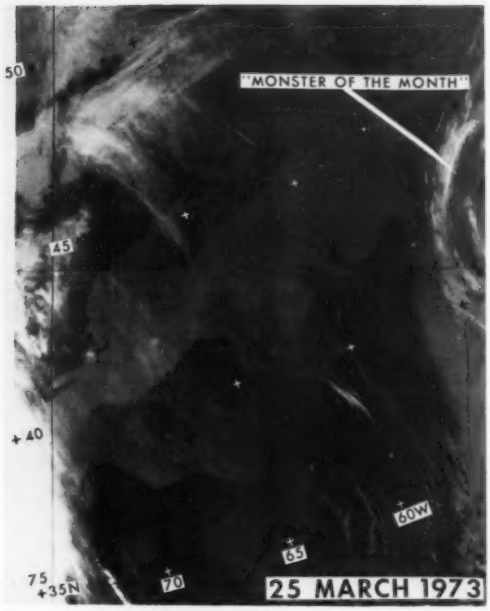

Figure 10. --Infrared image taken by NOAA-2 at the same time as figure 9 shows vividly the confused details of the North Wall of the Gulf Stream 2 days after passage of a severe East Coast storm.

picture in the Gulf of St. Lawrence. In winter, sea ice is generally detectable in both types of images. In spring, however, the radiation temperature of the ice is usually close to that of the water, and thus the ice/water boundary does not appear in the thermal image.

The entire scene took 3 min for the satellite to record. An almost instantaneous view, such as this, is of great value in understanding a dynamic current system as large and complex as the Gulf Stream. No other oceanographic research platform is capable of collecting sufficient data, in such a short period, to depict the ocean's surface thermal patterns in this way. Satellites are expected to play an increasing role in oceanographic monitoring and research, enabling the oceanographer to make more effective use of his vessels and aircraft.

GREAT LAKES NAVIGATION SEASON, 1973

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The 1973-74 Great Lakes navigation season opened on March 28, 1973, when the Soo Locks opened, the earliest ever. The locks had closed on February 8. The planned opening date for the Seaway, Welland Canal, and the U.S. Soo Canal was April 1, but favorable weather and ice conditions permitted advancing the date.

The British freighter DAVID, MARQUESS OF MILFORD HAVEN (fig. 11), was first into the Seaway at Montreal. The ship was also the first March transit of the Welland Canal by an overseas vessel. The Canadian freighter MENIHEK LAKE lead the eastbound traffic, also on the 28th. The first commercial vessel to use the Welland Canal's new 8-1/2-mi straight bypass channel downbound was the Canadian freighter SENNEVILLE. The TARANTAU was first upbound. Both of these vessels had wintered in or near the canal. The vessel honored as the "official" first--one arriving from the Lakes--was the Canadian laker J. W. McGIFFIN. The second vessel upbound in the Seaway was the Russian bulk carrier ZAKARPATYE (fig. 12). It passed through the Soo Canal on April 4, and became the first Soviet ship to transit this waterway and the earliest passage by an overseas vessel.

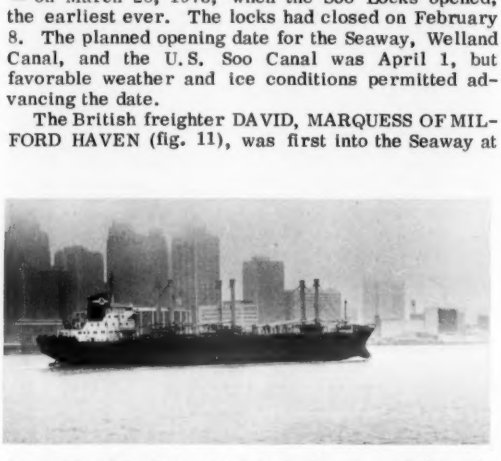

Figure 11.--The first salty into the Seaway and through the Welland Canal. It was also the first transit of the Canal by an overseas vessel in March.

The opening passage at the Soo was the JOHN G. MUNSON, for Duluth, with a cargo of coal. The MEDUSA CHALLENGER passed through the Straits of Mackinac on March 19, only 1 day later than the earliest recorded, which was in 1964 (fig. 49).

The 1973 navigation season closed on the St. Lawrence Seaway on December 22 and on the Welland Canal on January 4, 1974. The Seaway closing was extended from the 16th to the 20th, but adverse weather delayed the clearing of the waterway by the final vessels until the 22d. The last passages through the St. Lambert lock near Montreal were made by the

Figure 12.--The ZAKARPATYE, registered in the Black Sea port of Zhdanov, U.S.S.R., passes under the Detroit-Windsor bridge on its way to Duluth to load wheat and corn.

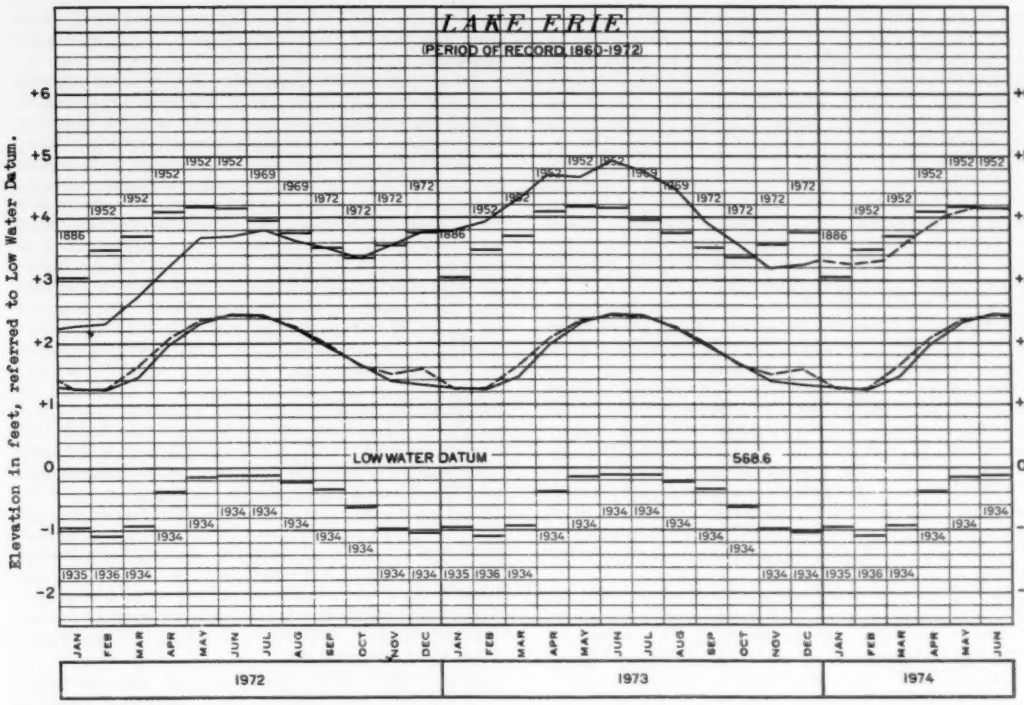

Figure 13.--In this graph of the water levels of Lake Erie, the top solid line indicates the recorded level, the dashed extension is the projected level for the next months. The lower solid line is average level for the period of record, and the dashed is the average for the last 10 yr. The extremes with year of occurrence are indicated by the short horizontal lines.

Panamanian freighter SEBASTIANO and the Canadian tanker ALEX HEIBERG.

The closing of the Welland Canal on January 4 marked only the second time that operations had extended beyond December. The previous season was 1971, when the canal closed on January 8, 1972. The final upbound passage was by the Canadian MANITOULIN on the 2d, and by the Canadian SAGUENAY, downbound on the 4th.

The Canadian lock at Sault Ste. Marie, on the St. Marys River, closed on December 12. The U. S. Soo Locks were scheduled to close on January 31, 1974, but operations were able to continue until February 7, when the ROGER BLOUGH was the last to lock through.

All the lakes were well above their average monthly mean levels. New record water levels were set on Lakes Erie (fig. 13) and St. Clair this year for all months except November and December. The highest for the year and all-time high for hourly data on Lake Erie was set June 17. The hourly record of 576.73 ft was measured at Toledo, Ohio. The monthly mean of 573.51 ft for Lake Erie was the highest to date. Major flooding and storm damage along the shore occurred at the time of the peaks. They were in November 1972 and April and June 1973. The forecast for midyear 1974 levels is for all lakes to be below midyear 1973, but 0.5 to 2.0 ft above their average.

Precipitation over the Great Lakes drainage basin averaged 33.87 in for 1973, about 2.3 in or 7 percent above the average yearly total of 31.58 in. Above-normal precipitation has occurred over the basin area for 6 of the past 7 yr. During the period March through June this year, the precipitation was 28 percent above normal. Table 3 indicates the annual data for 1972 and 1973 and the extent that the 1973 totals exceeded the 1900-73 averages.

Table 3.--Annual precipitation data for 1972-73.

	Great Lakes	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
1972 (inches)	35.97	32.22	34.97	35.32	39.70	43.67
1973 (inches)	33.87	30.84	33.98	33.34	37.01	38.16
1973 above avg.	+2.29	+1.13	+2.70	+1.95	+3.18	+3.80

Recent articles in the Mariners Weather Log concerning the Great Lakes and St. Lawrence Seaway appeared in Vol. 17, Nos. 3 and 5, and Vol. 18, No. 1.

NOAA NATIONAL WEATHER SERVICE AIDS, 1973

Full weather services were provided, as always, throughout the Great Lakes Navigation Season. Services were provided from the record early date of

March 26, 1973, through February 9, 1974. Unlike the previous 4 yr, navigation was not extended to a record late data because of severe ice conditions during early February 1974.

National Weather Service Forecast Offices at Chicago, Detroit, and Cleveland served as focal points for marine services. Marine radio stations at Duluth, Port Washington, Chicago, Rogers City, Buffalo, and Lorain broadcast coded open water forecasts (MAFOR) every 6 hr. They also broadcast gale and storm warning messages and Special Marine Warning Bulletins on receipt. Near-shore forecasts were issued routinely by 15 Forecast and Weather Service offices around the Great Lakes.

As the U.S. Coast Guard completed their new high-level VHF radio stations, safety broadcasts were gradually consolidated into their Group offices and, by the end of the season, 19 stations were making broadcasts of special weather messages, either locally or over wide areas, depending on their radio equipment. Five Coast Guard radio sites made regular bi-hourly broadcasts of Recreational Boating Forecasts during the boating season. Many others participated in a Marine Information Service Broadcast program sponsored by the National Weather Service and the Coast Guard, to provide the latest weather and notice-to-mariners information to commercial AM and FM radio stations.

Gale warnings during 1973 again increased over the previous year. A total of 372 gale warnings were issued, compared to 329 during 1972--an increase of about 7 1/2 percent. Storm warnings decreased from 37 in 1972 to 29 in 1973. Special Marine Warnings short-fuse weather hazards such as heavy thunderstorms or heavy fog totaled 195 for the year. No warnings were issued for any lake during July and August.

Marine Radio Station WMI in Lorain continued to broadcast the Great Lakes Weather Broadcast (LAWEB) every 6 hr. Radio Station WLC, Rogers City, Mich., began broadcasting the LAWEB during the season. Stations on the LAWEB were revised and expanded to provide data for a larger geographic area covered by new NWS plotting charts issued to shippers during 1973. The LAWEB was supplemented by material broadcast by NWS VHF-FM continuous weather stations along the shores of Lakes Erie, St. Clair, and parts of southern Lake Michigan.

As a result of the expanded radio coverage on Lake Erie, private flag displays of weather warnings and advisories were discontinued on the shore. Displays were continued only at selected Coast Guard facilities.

Late in the navigation season, through extension of Navigation Season funds, a radio facsimile system was used to transmit two weather forecast charts per day to some ships underway. With the cooperation of Lorain Electronics Corporation, wind and temperature forecasts were broadcast experimentally on public radio channels through VHF radio sites in Duluth, Port Washington, and Lorain. U.S. Steel Corporation's station in Rogers City also participated in the test program. Thirteen ships were fax equipped for the tests.

ICE SEASON, 1973

An article describing the 1972-73 Great Lakes Ice Season, by Daron E. Boyce, National Weather Service, Cleveland, Ohio, appeared on page 285 of the September 1973 issue of the Mariners Weather Log.

Two extremes of weather were observed during the 1972-73 ice season, resulting in one of the most unusual seasons in several years. Early freeze-ups in bays and many shallow water ports set the stage for a difficult start to the ice season, but by mid-January, a mild trend which was to last well into spring became established, and the 1973 Navigation Season got underway in record time.

NWS issued their first seasonal ice freeze-up outlook in mid-November, calling for the earlier than usual wintry conditions. The R.C. NORTON was the first ship to need icebreaker assistance. The troubled area was Green Bay, Wis. Other assists were logged within a few days in Saginaw Bay, Mich., St. Marys River, and western Lake Superior, near Duluth.

Regular ice season services began on December 15, 1972, at WSFO Detroit. The Forecast Office doubled its output with the issuance of a daily Ice Outlook and a daily Ice Forecast. Long-range ice conditions were also predicted graphically in 30-day ice outlooks, issued twice monthly. The NWS role in

Table 4.--Outlook for navigation season, opening spring 1973

Area	Forecast opening icebreakers	Forecast opening natural	Actual opening	Average opening	Earliest recorded opening
Duluth	April 2	April 11	* March 29	April 10	March 1, 1911
Whitefish Bay	March 30	April 10	** March 28		
St. Marys River	March 29	April 9	** March 28	April 14	March 22, 1942
Straits of Mackinac	March 24	April 7	* March 29	April 4	March 18, 1968
Green Bay	March 29	April 8	#** March 31	April 12	March 24, 1946
Southern Lake Huron	March 18	March 26	* March 14		
Saginaw Bay	March 26	April 1	Ice-Free March 15		
Detroit	March 18	March 26	*March 14	March 23	March 1, 1937
Western Lake Erie (Cleveland)	March 20	March 27	*March 20	March 24	March 1, 1937
Buffalo	April 4	April 14	* March 20	April 11	March 2, 1953

*Without direct icebreaker assistance

**With assistance or prior icebreaker transit

#Navigation on March 25 at Gladstone and Little Bay de Noc

supporting late season shipping was expanded, with the addition of a meteorologist at the Coast Guard Ice Navigation Center in Cleveland.

The harsh winter cold eased considerably in middle and late January, after rapid ice formation occurred in the early part of the month. Almost 100 ships were assisted by the Coast Guard in early January. Shipping diminished down to seven U.S. Steel carriers by February. The C. J. CALLAWAY and the A. H. FERBERT locked downbound at the Soo Locks on February 8, 1973, to set a new late season record--the fourth in as many years. Cold weather persisted through the remainder of February, and the ice cover increased to its maximum by the end of the third week.

March was unusually mild, and the warm weather persisted through the remainder of the spring. The "Outlook for the Opening of Navigation" was issued by the National Weather Service on March 5, 1973 (table 4)). Eastern Lake Erie, normally a spring problem area, was ice-free during most of March. Ice also decreased on the upper lakes, and the Soo Locks opened on March 28, 1973--the earliest spring start ever. NWS ice season services ended in mid-April, as the last vestiges of brash disappeared from Duluth Harbor. The average temperature for the period of November through March for all of the lakes was about 2° above normal.

GREAT LAKES VESSEL OBSERVATION PROGRAM, 1973

There were 33 vessels that participated in the Great Lakes weather reporting program this year. A total of 14,408 observations were sent by the participating ships. This was an increase of 1,877 observations over 1972. The data available at this time do not indicate any observations from the St. Lawrence Seaway, which is not unusual, or from Lake Ontario. The following number of observations were reported from the other lakes: Lake Erie, 798 by 28 ships; Lake Huron, 3,472 by 33 ships; Lake Michigan, 2,517 by 23 ships; Lake Superior, 7,621 by 33 ships.

During 1973, gale-force or greater winds (34 kt or greater) were reported on 131 days over the four lakes from which reports were received. There were 15 days with gales (34-40 kt) on Lake Erie, 43 on Lake Huron, 35 on Lake Michigan, and 66 on Lake Superior. Strong gales (41-47 kt) occurred 5 days on Lake Erie, 6 days on Lake Huron, 5 days on Lake Michigan, and 16 days on Lake Superior. Storm winds (48-55 kt) occurred 3 days on Lake Superior; and violent storm winds (56-63 kt), 1 day on Lake Michigan. December had the most days with an observation of gales or higher, followed by November and October. Table 5 shows the number of high wind observations by 10-kt categories.

Table 5. --Number of high-wind observations during the calendar year 1973

High-wind categories	Observations
Over 30 kt	625
Over 40 kt	50
Over 50 kt	1
Over 60 kt	0

A total of 82 observations were made of seas over 12 ft. There were 66 observations of waves 12 to 15 ft and 16 of 15 to 20 ft. January had the highest number of days and observations of high waves, with October second. The highest seas reported were 20 ft, by the ARTHUR M. ANDERSON on January 5 and May 3 and G. M. HUMPHREY on May 2 on Lake Superior.

Seas over 12 ft were reported on 3 days on Lake Erie, 11 days on Lake Huron, 7 days on Lake Michigan, and 39 days on Lake Superior. For all the Great Lakes, there were 57 days when one or more of the lakes had seas over 12 ft.

Tables 6 to 12 give summaries of the maximum winds for each lake by month, the highest wind by month on any lake, the highest 1 min wind by lake for each year since 1941, and the highest seas reported on each lake this year. The tables include only those observations that were logged and forwarded on the Great Lakes Observation Form 72-2.

Table 6. --Maximum wind speed reported on Lake Erie for each month by National Weather Service cooperating vessels (1973)

Month	Kt	Dir.	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January	41	360°	0600	29	CASON J. CALLAWAY	41.8	82.8
February	21	320°	0600	3	CASON J. CALLAWAY	41.9	83.0
March				(No observations received)			
April	37	310°	1200	28	JOHN SHERWIN	42.0	81.9
May	30	270°	1800	12	PAUL H. CARNAHAN	41.8	83.0
June	28	200°	0500	6	PAUL H. CARNAHAN	42.1	81.4
July	32	240°	0600	13	ROGER BLOUGH	41.9	82.9
August	26	240°	0600	12	CHARLES M. BEEGHLY	41.5	82.3
September	36	190°	1200	22	CHARLES M. BEEGHLY	42.2	81.1
October	45	230°	0600	14	CHARLES M. BEEGHLY	42.2	80.3
November	41	290°	0000	29	PAUL H. CARNAHAN	42.0	80.9
December	43	250°	1200	6	ROGER BLOUGH	41.9	81.7
Year	45	230°	0600	October 14	CHARLES M. BEEGHLY	42.2	80.3

Table 7. --Maximum wind speed reported on Lake Huron for each month by National Weather Service cooperating vessels (1973)

Month	Kt	Dir.	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January	40	230°	1200	4	G. M. HUMPHREY	44.5	83.0
February	28	120°	0600	1	PHILLIP R. CLARK	43.8	82.1
March	14	10°	0600	31	ARTHUR M. ANDERSON	44.7	82.9
April	44	250°	0000	17	EDMUND FITZGERALD	45.2	83.2
		60°	1200	10	BENJAMIN F. FAIRLESS	45.2	82.5
		70°	0600	10	BENJAMIN F. FAIRLESS	44.3	83.0
May	36	310°	1800	16	ERNEST T. WEIR	45.2	83.2
June	38	290°	0600	24	J. L. MAUTHE	43.6	82.5
July	29	210°	1200	30	JOHN SHERWIN	44.3	82.4
August	37	300°	1800	20	JOHN DYKSTRA	45.4	83.4
September	40	320°	1800	6	J. BURTON AYERS	44.3	83.1
October	43	280°	0600	14	LEON FALK JR.	44.1	82.7
November	43	280°	1800	1	JOHN SHERWIN	44.4	83.2
December	42	260°	0600	30	CASON J. CALLAWAY	43.8	82.5
				April			
Year	44	250°	0000	17	EDMUND FITZGERALD	45.2	83.2
		60°	1200	10	BENJAMIN F. FAIRLESS	45.2	82.5
		70°	0600	10	BENJAMIN F. FAIRLESS	44.3	83.0

Table 8. --Maximum wind speed reported on Lake Michigan for each month by National Weather Service cooperating vessels (1973)

Month	Kt	Dir.	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January	42	270°	1200	4	CASON J. CALLAWAY	43.2	87.4
February	36	330°	0000	3	A. H. FERBERT	44.8	86.9
March				(No observations received)			
April	37	170°	0000	21	JOHN SHERWIN	42.2	87.6
May	42	90°	1800	27	JOHN SHERWIN	45.5	85.4
June	28	190°	0000	9	ARTHUR M. ANDERSON	44.8	86.3
July	30	200°	1200	12	ENDERS M. VOORHEES	45.9	85.2
August	37	190°	1600	30	LEON FRASER	43.3	86.9
September	38	340°	0600	20	FRANK ARMSTRONG	45.7	86.2
October	37	80°	0000	29	WILLIAM A. IRVIN	45.2	86.3
November	42	270°	1800	1	WILLIAM A. IRVIN	45.8	84.7
December	56	40°	1200	13	J. L. MAUTHE	42.3	87.3
				December			
Year	56	40°	1200	13	J. L. MAUTHE	42.3	87.3

NOTABLE WEATHER HAPPENINGS, 1973

INTRODUCTION

This year, December was the stormiest month for shipping on the Lakes, as far as winds were concerned, both in number of days and observations. There were 26 days and 159 observations with winds over 30 kt. November was second and October third. The high seas did not follow the same pattern. January had the greatest number of high-seas days and observations, followed by October and December. January was a poor 6th in wind observations. The highest wind report--56 kt--was also in December, and the highest wave--20 ft--occurred 3 times, once during January and twice during May. There was only one storm that had a cooperating ship report of winds greater than 50 kt and two with 50 kt. There were two storms with 20-ft seas, but none over 20 ft.

High lake levels and above-average precipitation contributed to flooding and erosion. There were two especially severe and damaging storms; one on March 17 and 18 (figs. 14 and 15), and the other on April 10. These are described in the Smooth Logs for March and April 1973, in the September 1973 issue.

The following paragraphs describe some of the more severe storms that affected the Great Lakes during 1973, as far as shipping was concerned. February and March are not generally included because of the lack of shipping due to ice. Tracks of the most intense storms are shown in figure 16. All times are GMT.

JANUARY

There were four LOW centers that tracked directly over the Great Lakes. One of these resulted in wind observations of greater than 40 kt and produced one of

Table 9. --Maximum wind speed reported on Lake Superior for each month by National Weather Service cooperating vessels (1973)

Month	Kt	Dir.	Time (GMT)	Date	Ship	Lat. (°N)	Long. (°W)
January	42	360°	1800	28	LEON FRASER	47.5	88.2
February	28	170°	0600	6	CASON J. CALLAWAY	47.3	86.5
March	17	10°	1800	31	ARTHUR M. ANDERSON	47.0	86.0
April	40	60°	1800	9	G. M. HUMPHREY	46.9	91.6
May	48	50°	1800	2	MIDDLETOWN	47.3	85.3
June	35	60°	1200	16	JOHN DYKSTRA	47.2	90.2
July	38	360°	0600	12	ARTHUR M. ANDERSON	47.2	90.7
August	45	330°	0000	21	JOHN SHERWIN	46.5	85.2
September	46	140°	0600	25	J. L. MAUTHE	47.5	88.3
October	50	310°	1800	16	JOHN DYKSTRA	47.2	86.6
November	42	310°	0000	8	ASHLAND	47.4	89.0
December	50	50°	0600	5	J. L. MAUTHE	47.5	85.3
Year	50	310°	1800	October 16	JOHN DYKSTRA	47.2	86.6
		50°	0600	December 5	J. L. MAUTHE	47.5	85.3

Table 10. --Maximum wind speed reported for each month for the entire Great Lakes (excluding Lake Ontario) by National Weather Service cooperating vessels (1973)

Month	Kt	Dir.	Time(GMT)	Date	Lake	Ship	Lat. (°N)	Long. (°W)
January	42	270°	1200	4	Michigan	CASON J. CALLAWAY	43.2	87.4
		360°	1800	28	Superior	LEON FRASER	47.5	88.2
February	36	330°	0000	3	Michigan	A. H. FERBERT	44.8	86.9
March	17	10°	1800	31	Superior	ARTHUR M. ANDERSON	47.0	86.0
April	44	70°	0600	10	Huron	BENJAMIN F. FAIRLESS	44.3	83.0
		250°	0000	17	Huron	EDMUND FITZGERALD	45.2	83.2
		60°	1200	10	Huron	BENJAMIN F. FAIRLESS	45.2	82.5
May	48	50°	1800	2	Superior	MIDDLETOWN	47.3	85.3
June	38	290°	0600	24	Huron	J. L. MAUTHE	43.6	82.5
July	38	360°	0600	12	Superior	ARTHUR M. ANDERSON	47.2	90.7
August	45	330°	0000	21	Superior	JOHN SHERWIN	46.5	85.2
September	46	140°	0600	25	Superior	J. L. MAUTHE	47.5	88.3
October	50	310°	1800	16	Superior	JOHN DYKSTRA	47.2	86.6
November	43	280°	1800	1	Huron	JOHN SHERWIN	44.4	83.2
December	56	40°	1200	13	Michigan	J. L. MAUTHE	42.3	87.3
Year	56	40°	1200	13	Michigan	J. L. MAUTHE	42.3	87.3

Figure 14.--High lake levels and a severe March storm brought flooding to Mitchell's Bay, Ontario, on the 19th. Wide World Photos.

the highest wave observations. Another cyclonic system had several centers, none of which passed directly over the Lakes, produced the highest wind observation for the month.

The first significant storm moved northward out of the western Gulf of Mexico. The LOW center passed directly over Chicago about 0300 on the 4th. At 1200, the 994-mb center was near Blind River. At that time, the CASON J. CALLAWAY, on Lake Michigan near Milwaukee, was confronted by 42-kt westerly winds and 10-ft waves. On Lake Huron, the G. M. HUMPHREY had southwesterly winds of 40 kt and 10-ft waves. Later in the day at 1800, the A. H. FERBERT was hit by 40-kt winds on Lake Erie, and the ARTHUR M. ANDERSON had 38-kt northwesterly winds on Lake Superior. All the other boats fared better than the ENDERS M. VOORHEES, at 0600 on the 5th on Lake Michigan. She had winds of 36 kt, but the temperature had plunged to -14°C. There were

Figure 15.--High waves atop high water crash against lakeside summer cottages on Lake Ontario. The combination damaged many homes and businesses. Wide World Photos.

other gale-force wind reports on all the Lakes. The LOW moved toward the northeast and into Quebec. It was at 0000 on the 5th that the ARTHUR M. ANDERSON made one of the three highest wave observations of 20 ft. She was near the center of Lake Superior, east-southeast of Manitou Island, with 33-kt winds blowing from 300°. At 1800 on the 4th, after leaving the Soo Locks, she had 38-kt winds, but only 5-ft waves, which built as she moved toward the center of the lake, even though the wind speed decreased.

This storm was the multicentered one that came off the Gulf Coast. The first gale-force winds were on the 27th. There were several LOW centers over the United States, east of the Rocky Mountains, and a HIGH over Ontario. The 40-kt east-northeasterly wind report by the ARTHUR M. ANDERSON on Lake Superior at 1200 was associated more with the tight gradient around the HIGH than any of the LOWs. Late on the 27th and on the 28th, one of the LOWs moved up the East Coast, and it was in the northerly flow west of this storm that the LEON FRASER was hit by 42-kt winds from 360° at 1800 on the 28th. At 0000 on the 29th, the A. H. FERBERT recorded 38-kt northerly gales on Lake Huron.

APRIL

Five storm centers passed over or near the Lakes. Two produced wind reports of 40 kt or greater and a 16-ft wave report. A waterspout occurred over Lake St. Clair on the 1st.

The first storm produced four reports of 40 kt or greater and two of the three reports of 44 kt, the highest of the month. The storm developed over Arkansas early on the 9th. It developed very rapidly and moved into Michigan on the 10th, but another LOW was developing over the East Coast and took over the circulation center on the 11th.

At 1800 on the 9th, there were two high wind reports on Lake Superior. The ERNEST R. BREECH near Duluth found 39 kt, and the G. M. HUMPHREY 40-kt, east-northeasterly winds. On Lake Erie, the EDMUND FITZGERALD had 39-kt winds from the east. There were reports of 15-ft waves on the shores of Lake Michigan and widespread flooding on the western shores of Lakes Erie, St. Clair, and Huron. The western end of Lake Erie reached a record high water level above low water datum near Toledo. On the 10th, the BENJAMIN F. FAIRLESS was headed northeast on Lake Huron. At 0000, she measured 40 kt, and, at 0600 and 1200, measured 44-kt winds, all from the east-northeast. The seas were running 7 to 8 ft. The highest seas were 13 ft on Lake Superior, where the winds were in the low to middle 30-kt category. By the 11th, with the shift of the center to over Maine, the wind speed decreased rapidly and the direction shifted to northwesterly.

The 17th brought another storm that resulted in 44-kt winds. The center that produced these developed over Lake Superior on the 16th. At 0000 on the 17th, it was centered over the southern tip of James Bay. The EDMUND FITZGERALD was near the center of Lake Huron, where the winds increased to 44 kt out of the west-southwest. At that time, there were reports of over 30 kt on all the Lakes except Michigan. The WILLIAM A. IRVIN contended with 32-kt winds on Lake Erie, and the RESERVE, slightly southeast of the FITZGERALD, measured only 35-kt winds. By

Table 11. --Highest 1-min wind (kt) reported on the Great Lakes by U.S. anemometer-equipped vessels

Year	Lake Erie		Lake Huron		Lake Michigan		Lake Superior		Lake Ontario	
1941	W	42	WSW	50	NW	43	NNW	54	--	--
1942	WSW	52	WSW	56	WNW	48	S	62	--	--
1943	WSW	57	WNW	43	SSW	50	WSW	52	--	--
1944	NE	38	NW	37	WSW	48	NNE	42	--	--
1945	WNW	52	SSW	54	WNW	49	NW	52	--	--
1946	SW	50	W	46	S	44	NW	47	--	--
1947	NW	51	SSE	43	ENE	39	WSW	43	--	--
1948	WSW	40	NNW	51	NW	45	WSW	48	--	--
1949	W	52	NNE	50	NNW	43	N	52	--	--
1950	SW	70	NW	48	NW	49	NW	81[1]	--	--
1951	WSW	37	WSW	50	SW	49	WSW	54	--	--
1952	SW	46	SW	57	SSW	44	WSW	45	--	--
1953	WSW	49	NW	45	NNW	46	ENE	50	--	--
1954	W	45	NW	45	E	48	N	43	--	--
1955	W	52	SW	57	WSW	58[1]	NW	48	--	--
1956	WSW	46	W	43	SSW	46	N	50	--	--
1957	WSW	72	SW	54	WSW	49	W	47	--	--
1958	SW	61	SW	43	SW	52	SSW	54	--	--
1959	W	42	NE	50	E	48	W	54	--	--
1960	NE	55	WSW	49	NW	55	N	54	--	--
1961	W	50	NW	47	NW	48	N	57	--	--
1962	NW	52	WNW	63	NW	48	NNW	60	--	--
1963	NNW	74[1]	NW	60	N	52	NNW	52	E	35
1964	WSW	68	W	72	NW	54	WSW	62	WNW	50[1]
1965	WSW	60	WNW	95[1]	ESE	52	SW	70	W	40
1966	ENE	49	NE	60	NW	57	NNE	61	W	39
1967	WSW	43	W	58	ENE	55	N	53	W	32
1968	W	63	NNW	44	WNW	46	NNE	55	SW	31
1969	WSW	44	NNW	46	NW	50	SSW	50	--	--
1970	W	52	W	62	NW	52	W	63	--	--
1971	SW	50	N	53	N	50	SW	56	--	--
1972	W	45	NW	56	N	54	NNE	60	--	--
1973	SW	45	ENE	44	NE	56	NE	50	--	--

[1]Highest for each lake

0600, the only reports of near-gale or gale winds were on Lake Superior, as the center moved northeastward.

MAY

There were five cyclone centers that passed over the Lakes this month. The storm that moved over the Lakes on the 2d produced more gale-force winds than all the other four storms put together. It also produced the highest seas; its two reports exceeded January's one report of 20-ft seas.

The storm formed over the Texas-Oklahoma panhandle on the 1st and moved northeastward. It was over Lake Michigan at 1200 on the 2d. By 1200 on the 3d, the storm's center was over southwestern Quebec. During this period, the lowest pressure was 999 mb. The high winds were almost entirely confined to the north and west side of the LOW and over Lakes Superior and Michigan.

The first ship reports of gale-force winds started at 1800 on the 1st. At that time, the ROGER BLOUGH, on upper Lake Michigan, was lashed by 37-kt easterly winds. The JOHN SHERWIN and A. H. FERBERT on Lake Superior both suffered 40-kt winds and seas of 10 to 12 ft. The worst period was on the 2d and 3d, when the highest wind and waves occurred, all on Lake Superior. At 0000 on the 2d, the G. M. HUMPHREY was buffeted by 20-ft seas on western Superior, and, at 0000 on the 3d, the ARTHUR M. ANDERSON found they had moved to the central part of the lake.

At 1800 on the 2d, the MIDDLETOWN was approaching Whitefish Bay when she was hit by the highest wind of the month--48 kt. To the northwest, the EDMUND FITZGERALD was fighting 47-kt winds. Between 1800 on the 1st and 0000 on the 3d, there were 12 reports of winds 40 kt or greater from one end of Lake Superior to the other. As the LOW moved off to the northeast later on the 3d, the winds decreased to near gales over both Lakes Michigan and Superior. On the 4th, there were still reports of winds over 30 kt, but they had shifted from the northeast to the northwest.

There was one other report of winds over 40 kt during the month. That was 42 kt on the 27th, over

Table 12.--Highest seas reported on the Great Lakes (excluding Lake Ontario) by National Weather Service cooperating vessels for 1973

Lake Erie:	ROGER BLOUGH on December 6--16 ft
Lake Huron:	LEON FRASER on December 27--18 ft
Lake Michigan:	PHILLIP R. CLARK on October 7--18 ft
Lake Superior:	ARTHUR M. ANDERSON on January 5 and May 3, and G. M. HUMPHREY on May 2--20 ft

upper Lake Michigan, by the JOHN SHERWIN.

JUNE

This was a rather quiet month. There were only four reports of winds greater than 30 kt. None of these were associated with well-developed storms. The fastest wind speed of 38 kt occurred at 0600 on the 24th, on Lake Huron. It was reported by the J. L. MAUTHE, with current weather "squalls in sight." The next highest wind was 35 kt on Lake Superior, at 1200 on the 16th, by the JOHN DYKSTRA. At 0600 on the 17th, the ERNEST R. BREECH, near Duluth, was hit by northeasterly 32-kt winds. At the same time, she reported "thunder heard," and the past weather was thunderstorms. The other of the four reports was also by the JOHN DYKSTRA, at 0000 on the 6th, of 33-kt west-southwesterlies. The LEON FRASER found 13-ft seas on Lake Superior at 1800 on the 16th, with 27-kt winds.

JULY

Only one cyclone center moved over the Great Lakes, and that was Lake Superior, on the 26th, and it did not produce any significant winds or waves. Generally, the high winds and waves are associated with frontal activity and thunderstorms. As in June, there were only four reports of winds greater than 30 kt. The highest of 38 kt occurred at 0600 on the 12th over Lake Superior and was associated with thunderstorm activity. Thunder heard was reported as present weather by the ARTHUR M. ANDERSON, with past weather indicating thunderstorms. An occluded front was approaching from the west.

On the 14th, the LEON FALK was in the northwesterly flow behind the cold front near central Lake Superior, where it was hit by 35-kt gales. As the warm front moved over Lake Erie on the 13th, the ROGER BLOUGH measured 32-kt southwesterly winds at 0600. The ERNEST R. BREECH reported 32-kt northeasterly winds at 1800 on the 30th over Lake Superior. They had rain during the past hour, but not at the time of the observation. The FRANK ARMSTRONG reported the highest seas of the month, which were 12 ft on Lake Michigan on the 21st.

AUGUST

Although there were no persistent major cyclone centers that tracked over the Great Lakes this month, there were many small short-lived LOWs of less than 24-hr duration. Temperatures over the lakes were above normal.

The month got off to a good start with a waterspout reported over Wild Fowl Bay on the east shore of Saginaw Bay at 1445 on the 1st. It was reported that water was lifted 25 ft into the air. At the time, a small LOW was over Lake Erie.

Except for two reports, one on the 29th and the other on the 30th, all winds over 30 kt were measured on the 20th and 21st. They occurred on all Lakes except Erie. A north-south-oriented cold front moved eastward across the Lakes, between late on the 19th and early on the 21st. At 0000 on the 21st, in Whitefish Bay, the JOHN SHERWIN found 45-kt west-northwesterly winds. A small wave was moving northward on the front at that time. There were 14 reports of winds higher than 30 kt between 1200 on the 20th and 0600 on the 21st. All were behind the front in the northwest to northerly flow. Only one, at 1200 on the 20th, by the JOHN SHERWIN on Lake Huron, indicated thunderstorm activity. The remainder indicated fair weather. The highest seas were 12 ft, reported by the LEON FRASER on Lake Michigan on the 29th.

SEPTEMBER

The number of observations with winds over 30 kt more than tripled over last month. There were two cyclone centers that tracked directly over the Lakes. The highest wind reported for the month was associated with a front, rather than directly with the cyclone center which was located in central Canada. The 46-kt wind from the southeast was measured by the J. L. MAUTHE on Lake Superior at 0600 on the 25th. The highest wave was 16 ft, on Lake Michigan; it was observed by the ENDERS M. VOORHEES on the 19th.

The cyclone center that moved across Lake Superior on the 22d resulted in a large percentage of the higher wind and wave reports. The highest wind report with this storm was 38 kt on Lake Superior at 0600 on the 22d, by both the JOHN DYKSTRA and PAUL H. CARNAHAN. At 1200, the CLIFFS VICTORY reported seas of 15 ft. Gale-force winds were reported on all the Lakes except Ontario.

On the morning of the 12th, a waterspout was sighted over Lake Huron, 30 mi east of Alpena.

OCTOBER

This transition month between summer and winter saw an increase in both the number and intensity of cyclone centers affecting the Lakes and the number of high winds observed. There were six cyclone centers that moved over the Lakes.

The fastest wind--50 kt--was associated with a storm that formed north of Lake Huron on the 14th. It moved northeastward. By the 16th, the 980-mb center was over northern Quebec and dominated the eastern half of Canada and the northeastern United States. A large, elongated HIGH occupied the remainder of the United States and Canada. It was in the tight gradient between these two pressure centers that the JOHN DYKSTRA encountered the 50-kt northwesterly wind on Lake Superior at 1800 on the 16th.

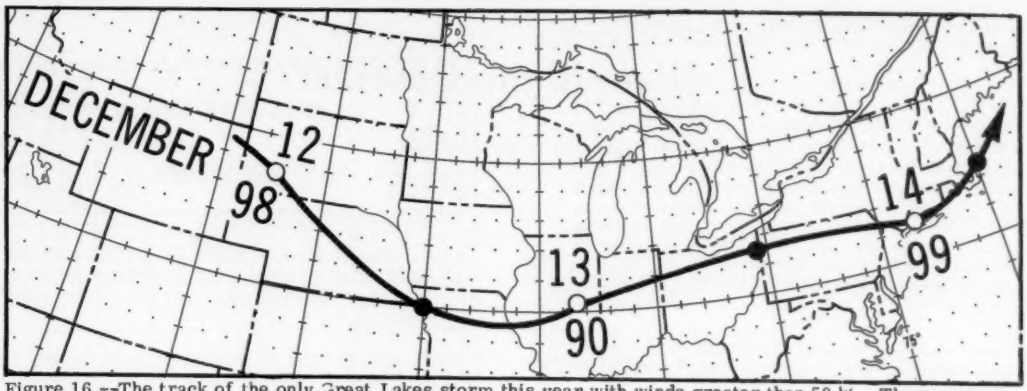

Figure 16.--The track of the only Great Lakes storm this year with winds greater than 50 kt. There were no storms with open-water seas greater than 20 ft. There were two storms with winds of 50 kt and two other storms with seas of 20 ft, but they did not exceed those values. Open circle indicates position of center at 1200 of date shown, and closed circle indicates 0000 position. Figure below open circle indicates pressure to nearest millibar.

There was no report of seas included with the observation, but it is likely they were high, as northwesterly winds of over 40 kt had been blowing for about 24 hr. The highest wave reported on Lake Superior this month--16 ft--was with this storm, at 0600 on the 16th. It was the second highest for any of the Lakes.

Lakes Erie and Huron had their highest winds of the month earlier, on the 14th, when this storm was forming. On Lake Erie, it was 45 kt at 0600 on the 14th, by the CHARLES M. BEEGHLY, and, on Lake Huron, 43 kt, at the same time, by the LEON FALK. Lake Michigan fared well this month, with few gale-force or stronger winds.

The highest waves of the month were reported on Lake Michigan on the 7th. They were 18 ft and were reported southeast of Milwaukee by the PHILLIP R. CLARKE.

NOVEMBER

The strong winds are more closely related to the cyclone centers this month. There were eight centers that moved directly over the Lakes. One cyclone center that formed east of Lake Winnipeg and crossed eastward north of the Lakes harassed many ships. The fastest wind of 43 kt was observed on Lake Huron at 1800 on the 1st and swept the JOHN SHERWIN. The highest waves were 16 ft on Lake Superior on the 8th, rolling the CASON J. CALLOWAY.

There were eight reports of the next highest wind speed--42 kt--which occurred on all four lakes. The ASHLAND was one of the lakers that fought these winds on the 8th. The problems of snow and freezing air temperatures had now been added. The high winds were from the northwest quadrant 75 percent of the time.

DECEMBER

This is the month that produced the highest wind of the year. The J. L. MAUTHE, on Lake Michigan north of Gary, Ind., was lashed by the 56-kt winds from the northeast. The 989-mb storm center was over central Illinois at the time (fig. 16).

There were eight cyclone centers that tracked across the Lakes, including this one that brushed the southern edge of Lake Erie.

The highest waves were on Lake Huron, measured at 18 ft by the LEON FRASER on the 27th. At that time, the cyclone center which was involved was located over Saginaw Bay. The LEON FRASER was about 100 mi to the north.

The cyclone that produced the fastest wind originated in the U.S. Northwest on the 11th. As it moved across the Midwest, a high-pressure area over the Gulf of Mexico fed warm, moist air into its circulation. This resulted in intensification as the center passed the Lakes. At 0000 on the 13th, the J. L. MAUTHE had been pushed by 46-kt winds from the north as she moved southward. Later on the 13th and early on the 14th, as the storm moved south of Lake Erie, 40-kt winds were measured by three ships on Lake Huron. Waves of 12 ft were the highest reported by the JOHN SHERWIN. Lakes Michigan and Huron suffered the brunt of this storm.

A storm that crossed over Lake Michigan near Green Bay on the 5th produced a large number of gale-force winds. At 0600 on the 5th, J. L. MAUTHE was in Whitefish Bay, headed for the Soo Locks, when she was hit by 50-kt northeasterly winds. The J. L. MAUTHE reported the three highest winds this month. There were nine reports of winds 40 kt or greater as this storm moved through the area. Seas of 16 ft and 43-kt winds were reported by the ROGER BLOUGH on Lake Erie on the 6th. This was the highest wave report on Lake Erie for the year. The winds were from 250°, along the length of the Lake, and probably set up a seiche action on the Lake.

ACKNOWLEDGMENTS

I wish to express thanks to the many masters and mates aboard the cooperating Great Lakes vessels for their valuable observations and contributions to the National Weather Service observing program. Much useful information and pictures were obtained from Albert G. Ballert and the Great Lakes News Letter of the Great Lakes Commission. National Weather Service and ice data were obtained from Daron E. Boyce of the Ice Navigation Center.

Of primary importance are the listings of wind and wave data supplied by the National Climatic Center of the Environmental Data Service, Asheville, N.C., on which much of the article is based.

Hints to the Observer

HURRICANE REPORTING

Dear Captain:

We are asking your cooperation during the oncoming hurricane season (June through November) by intensifying your weather reporting--especially in the tropics.

To assist our forecasters in determining storm location, intensity, and movement, we would like you to:

1. Make and transmit reports at least at 3-hr intervals when within 300 mi of a tropical storm or hurricane.

2. Include in transmitted reports and on observation logs the lowest pressure and highest wind encountered if the pressure was more than 5 mb lower and/or the wind was more than 15 kt higher than the values included in the transmitted message. Example: 0800Z LOWEST PRESSURE 970MB 0730Z HIGHEST WIND 85KT.

"General Instructions for Radio Reporting of Weather Observations" contains general guidelines for transmission of radio weather messages from all cooperative ships.

The National Weather Service appreciates the time and effort you and your officers give to provide reports of weather conditions at sea. Your reports are extremely important, considering the vast ocean spaces and the relatively few ships that report weather.

Sincerely,

George P. Cressman
Director, National Weather Service

GENERAL INSTRUCTIONS FOR RADIO REPORTING OF WEATHER OBSERVATIONS

Standard Synoptic Observation Times--The regular weather reporting hours are 0000, 0600, 1200, and 1800. Occasionally, watch schedules or priority of other duties make it impractical to make and/or transmit surface observations at the standard synoptic time. To ensure message transmission, observations may be made an hour in advance of the standard hour. In these cases, the actual time of observation should be reflected in the message to be transmitted.

Special Requests for Observations--During tropical or extratropical storm situations, the National Weather Service may request ships located in areas of suspected storm development to take special observations at more frequent intervals than the routine 6-hr synoptic observation times. If your ship happens to be in such an area, your report will be helpful, even though local conditions may not appear bad enough to warrant a special observation. To speed delivery of messages from storm areas and to identify them as such, the word STORM should appear immediately following the radio address.

Observations During Storm Conditions--Whenever TROPICAL STORM, TYPHOON, OR HURRICANE conditions are encountered anywhere, "SAFETY OF LIFE AT SEA CONVENTION," Chapter V, requires all ships to take a special observation and transmit the report to the closest national meteorological service via the most convenient radio station. As long as the ship is in the storm area, it is highly desirable that weather reports be transmitted hourly, if possible, but, in any case, not less frequently than every 3 hr.

The lowest pressure and highest wind velocity observed during a tropical storm or hurricane period are of extreme value to marine forecasters. However, these extreme values are not often readily detected from routine ships reports, since these events frequently occur at times other than the regular observation times. A good example of this loss of information can be seen from the barograph trace from the EXCELSIOR (fig. 17). If only the ship's 0600 and 1200 observations were received at a forecast center, the forecaster would have seen only reports of pressures of approximately 1000 mb in the area traversed by the EXCELSIOR, while, in fact, a low pressure reading of 976.5 mb was recorded during the 6-hr period. It is realized that the ship could have been transmitting 3-hr and even hourly reports, enabling the lowest pressure reading to reach the forecaster. However, if any of the intermediate reports were not received, the forecaster would have missed this important information.

Observations in Coastal Waters--Radio weather reports are always needed from ships in coastal waters, therefore, observations should be taken without regard to distance from the coast, ship's routine permitting.

Coded Weather Messages--All messages to be transmitted by radio should be transcribed from the ship's weather log to NOAA 72-4, "Weather Report for Immediate Radio Transmission," in the ship synoptic code FM21E and given to the Radio Officer.

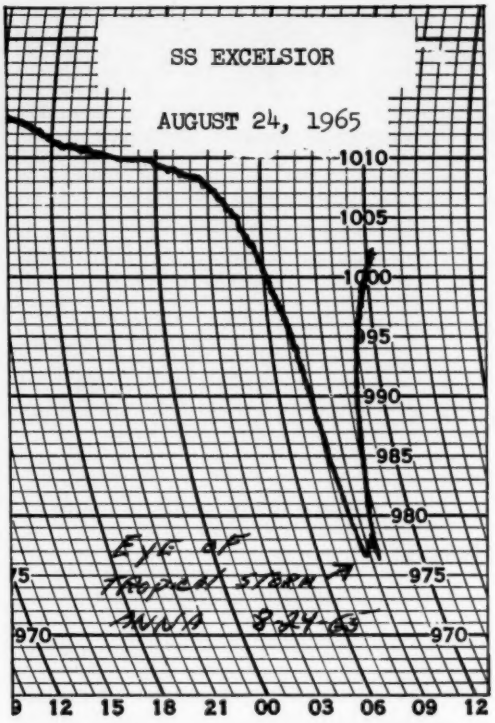

Figure 17.--Barograph trace from EXCELSIOR as it passed through hurricane Anna near 39°N, 51°W.

Weather Message Addresses for Transmission to U. S. Radio Stations--Use "OBS METEO WASHDC" when in the:

- Western North Atlantic, including the Gulf of Mexico and Caribbean Sea north of 3°N latitude and west of 35°W longitude (WMO REGION IV-A)
- Eastern North Pacific, north of the equator and east of the 180th meridian (WMO REGION IV-A)
- Eastern South Pacific, south of the equator from South America coast to 120°W longitude (WMO REGION III-B)

Use "OBS METEO GUAM" when in the Western North Pacific, between 5° and 25°N latitude and from 135°E longitude to the 180th meridian (WMO GUAM ZONE).

NOTE: A National Weather Service Forecast Office may request ships located in areas of suspected storm development to take special observations. These messages should be addressed to the requesting forecast office. For example, "OBS METEO (requesting NWS Office) STORM 99305 70750, etc."

Transmission of Radio Messages--Weather messages should be transmitted as soon as possible to the most convenient, preferably Government or U. S. Coast Guard radio stations, in accordance with instructions contained in United States and Foreign Coastal Radio Stations Accepting Ship's Weather Observation Messages.

If a message cannot be transmitted within 3 hr after a standard time, no further attempt should be made, unless the observation was made in the Southern Hemisphere or it reflects severe weather conditions not included in the latest forecasts. Observations delayed more than 12 hr should not be transmitted.

World Wide Weather Reporting--You are urged to contribute to this World Meteorological Organization (WMO) program by transmitting weather reports to national meteorological services responsible for collecting ship observations in all parts of the world.

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

CORRECTIONS TO PUBLICATION WORLDWIDE MARINE WEATHER BROADCASTS

Introduction, page ix--In the fourth paragraph, amend "Section 2" to read "Section 3," and in the fifth paragraph, amend "Section 3" to read "Section 2."

Page x-- Amend "Section 2" to read "Section 3" and vice versa, amend "Section 3" to "Section 2."

Page 12--Chatham, Mass. (WCC): Opposite "0050, 1250, 1650," change contents to read "Forecasts and warnings for the area affected." Area affected was recently changed to (a) Offshore waters: 32°-41°N, west of 65°W (West Central North Atlantic Waters); (b) New York Harbor.

Page 13--New York, N.Y.: Under "Area affected," change description of coastal waters to read "Block Island, R. I., to Virginia Beach, Va."; add (c) New York Harbor. Opposite NMY, change times of broadcast to read "0020, 1220, and on receipt[2]." (During boating season May 15-Oct. 15, there are also broadcasts at 2345, 0845, 1145, 1445, 1745, and 2045.) Enter the same change in appropriate space in bottom section. Change NMY class of emission and power to A_3H, 125 watts. Change WOX class of emission and power to A_3H, 400 watts. Change con-

tents of 0015, 1215, and 1715 broadcasts to read "Forecasts and warnings for area affected."

Page 13--Ocean Gate, N. J.: Add to "Area affected": (c) Offshore waters: 32°-41°N, west of 65°W (West Central North Atlantic Waters). Change Radio WOO broadcast times from "0130, 1330" to "0100, 1300." Change WOO class of emission to A_3A. Add WOO frequencies: 4403, 8754.4, 13172, 17318, and 22653.5 kHz. Note that the second set of column headings was inadvertently omitted; it should appear above the last line on the page. On page 14, amend contents of the 0015, 1215 broadcasts to show forecasts for area c are included.

Page 14--Cape May, N. J.: Add to area affected "Delaware Bay." Delete the 0000 and 1200 broadcasts. Change class of emission to A_3H and power to 150 watts.

Page 15--Wilmington, Del.: Delete the WEH and WLF broadcasts; they have been discontinued.

Page 15--Baltimore, Md.: Opposite NMX, change class of emission to A_3H.

Page 16--Norfolk, Va. (NAM): Change 185 kHz to 134.9 kHz.

Page 17--Norfolk, Va. (NMN, WGB): Change "Area affected" to read: (a) West Central North Atlantic waters (32°-41°N, west of 65°W); (b) Coastal waters--Cape May, N. J., to Savannah, Ga., including Chesapeake Bay. Albemarle and Pamlico Sounds. Under "Class of emission," change A_3 to read A_3H (applies to both Radio NMN and WGB). Opposite "0120, 1620," change "Warnings" to "Forecasts," and in "Contents," change to read "Forecasts and warnings for area a. Warnings for area b." Opposite "0500, 1100, etc.," amend contents to read "Forecasts and warnings for area affected."

Page 18--Charleston, S.C.: Change area description to read "Cape Fear, N. C., to Savannah, Ga." Change class of emission to A_3H (both stations). At 0420 and 1620, only warnings are broadcast.

Page 18--Jacksonville, Fla.: Change NMV class of emission to A_3H. Call letters should be changed to NMV-3.

Page 19--Ojus (Miami), Fla. (WOM): Amend "Area affected" to read "Southwestern North Atlantic Waters, Caribbean Sea, and Gulf of Mexico." Delete the 1700 and 2300 broadcast times. Change the class of emission to A_3A. Insert new broadcast times of 0400, 1200; the frequencies used at 0400 and 1200 are: 4428.6; 8792.8; 13137; 17325; 22688.5. The class of emission is A_3A. Revise description of contents of the 0400, 0500, 1100, 1200 broadcasts to read "... for the area affected." (As noted in Notice to Mariners 13-74, the Radio WAX broadcasts have been discontinued.)

Page 20--Miami, Fla.: Amend "Area affected" to read "(a) Southwest North Atlantic Waters; (b) Coastal waters: Cape Canaveral, Fla., to Tarpon Springs, Fla." The Radio NMA A1 broadcast at 0100 and 1600 now contains forecasts for the Southwest North Atlantic waters. An appropriate note to that effect should be entered on the page. The call letters, opposite 2670 kHz should be changed from NMA to NCF. The class of emission is A_3H. In the list of broadcast times for NCF, delete 0500 and 1700; add 2200. The contents of the NCF broadcasts are now "Forecasts and warnings for West Palm Beach to Isla Morada, Fla." (Note: The NCF broadcasts are intended primarily for recreational boatmen.) The description of the WDR broadcast was inadvertently omitted; please enter "0015, 1215 / Forecast / Forecasts and warnings for area affected."

Page 20--Tampa, Fla.: Change WPD broadcast time to read "1830 (1 hr earlier during Daylight Saving Time)." Change WFA class of emission to A_3H. Add note that WFA broadcasts are 1 hr earlier during Daylight Saving Time. Add frequency 157.2 MHz (Channel 24).

Page 21--Mobile, Ala.: Delete the CW frequencies 4256, 12885, and 22569. Change 8722 kHz to read 8474.5 kHz. Change times of A3, F3 broadcasts to read "0500, 1100, 1700, 2300 (broadcast 1 hr earlier during Daylight Saving Time). Delete all F1 frequencies except 8714.5. Change F1 broadcast time "2300" to read "0020." Add F3 frequencies 161.95 and 162.00 MHz.

Page 22--New Orleans, La.: NMG class of emission for 2670 kHz is now A_3H. Radio WAK: delete 2558 kHz and add 4419 kHz; change A3 to A_3H. Below the second set of column headings, change broadcast times "0500, 0550, etc.," to read "0500, 0550, 1150, 1400, 1750, 2350. Note that Radio WAK broadcast times are 1 hr earlier during Daylight Saving Time.

Page 23--Galveston, Tex.: Opposite KQP add 2450 kHz; A_3H, 400 watts; change class of emission and power of 2530 kHz transmission to A_3H and 400 watts also. Add note that KQP times of broadcast are 1 hr earlier during Daylight Saving Time.

Page 24--Port Isabel, Tex.: Change class of emission to A_3H. Change times of broadcast to 0000, 1400, 1800, and note that broadcast is 1 hr earlier during Daylight Saving Time.

Page 24--San Juan, Puerto Rico: Add Station WCT/ On receipt/2134 and 2530 kHz/A_3H/Contents--Warnings.

Page 52--Seattle, Wash.: Below second set of column headings, change "0430, 0500, 1700" to read "0500, 1700." Transfer all entries pertaining to NMW (Westport) to the listing for Astoria, Oreg., on the same page. Add note that KOW broadcasts are 1 hr earlier during Daylight Saving Time. Change NMW43 and KOW class of emission to A_3H.

Page 56--San Francisco, Calif. (KPH): Change frequency 22557^3 to 22479^3. Revise data below second column heading as follows:

Time of broadcast	Type of message	Contents of message and remarks
0500	Forecast Situation	Forecasts and warnings for areas b and c. Weather synopsis.
1700	Forecast Situation	Forecasts and warnings for areas a and b. Weather synopsis.
2300	Forecast Situation	Forecasts and warnings for areas a, b, and c.
On receipt	Warnings	Gale/storm/hurricane warnings.

[1] See figure 12, page 53.
[2] Frequency used during night.
[3] Frequency used during day.

Page 58--San Francisco, Calif. (KLH). Change class of emission and power to A_3H, 400 watts.
Page 103-Boston, Mass.: Revise "Schedules" to read: Ice conditions [1] 1600; wind and sea-height analysis/24-hr wind and sea-height prognosis [2] 1830; surface analysis/24-hr surface prognosis 1850.
Page 111-Honolulu, Hawaii: Revise "Schedules" and "Map areas, etc." as follows:

Schedules: Surface analysis (Map A) 0037, 0716, 1300, 1913; 24-hr surface prognosis (Map B) 0052, 1315; 60-hr long-range forecast (Map B) 0706; test chart (actual chart used) 0655, 1130, 1905, 2310.

Map areas, projection, and scales:
A: 25°S-40°N and 160°E-110°W
B: 10°S-40°N and 160°E-110°W
Mercator projection, true at 22°30'N and S, 1:20,000,000.

Note: Transmissions are on 2 frequencies only, depending on radio propagation conditions. For some time to come, the choices are likely to be 11090 and 2331.5 kHz.
Start signal: 300 cps transmitted for 5 seconds
Phasing signal: 95% black + 5% white per scan, transmitted for 22 seconds
Stop signal: 450 cps transmitted 5-7 seconds

Hurricane Alley

Richard M. DeAngelis
Environmental Data Service, NOAA
Washington, D. C.

HURRICANE LOTTIE

The following excellent report on hurricane Lottie was sent to us from A. P. Anfinson, the Meteorologist-in-Charge of the Meteorological Office at Nadi Airport, Fiji.

Tropical cyclone Lottie developed from a shallow depression south of the Solomon Islands on December 3 and 4. It moved steadily toward the east-southeast, until the 8th, when it was centered about midway between the New Hebrides and Fiji. It began to deepen. On the evening of the 9th, it moved directly eastward over the island of Kadavu, Fiji, with maximum winds estimated at 60 to 65 kt and a minimum pressure down to 963 mb. One person was killed on Kadavu, and an estimate of the damage was provided by the aircrew of a Royal New Zealand Air Force aircraft that flew low over the island the following day. Their report read:

"FOR MET NFFN HURRICANE DAMAGE AT KADAVU ASSESSED AT 30 TO 40 PERCENT OF VILLAGES DESTROYED ON NORTH COAST, 50 TO 60 PERCENT OF VILLAGES DESTROYED ON SOUTH COAST, 5 PERCENT OF GOVERNMENT BUILDINGS DESTROYED AND TREE DAMAGE ASSESSED AT 20 TO 30 PERCENT OVERALL."

Lottie continued her eastward movement from Kadavu, passing just north of the weather station on the Island of Matuku on the early morning of the 10th. Widespread damage, including houses blown down and trees uprooted, occurred on Matuku. The lowest pressure reported from the Matuku weather station was 966.8 mb, and the maximum wind speed (estimated, since the weather station has no anemometer) was given as 70 kt. As Lottie moved eastward, its strong winds and high seas sank the auxilliary ketch MAKOGAI near the island of Fulaga, at about 2330 on the 9th. About 45 mi further to the southeast, the ULUILAKEBA (212 tons) capsized at about 0130 on the 10th. Five of the 26 persons on board the MAKOGAI were lost; the others swam or were washed ashore on Fulaga. Of the 106 persons on board the ULUILAKEBA, only 41 survived.

Lottie was unusual in having a very small core of strong winds. It is estimated that the diameter of gale-force winds was only about 65 to 70 mi, while the diameter of storm-force or greater winds was only about 40 mi.

A significant finding of the court of inquiry into the sinking of the two ships was that neither of the ships' captains listened to the shipping forecasts (which gave a very accurate forecast of the cyclone's speed and direction of movement), which are broadcast hourly over Suva Radio, 3DP.

AUSTRALIA'S JANUARY FLOODS

Month-long rains capped by several days of heavy downpours turned sections of Queensland and New South Wales into an inland sea, toward the end of January. Brisbane was hit hard. The southern shore of the Gulf of Carpentaria was temporarily extended. In New South Wales, the area around Bourke was flooded by the Darling River, and coastal sections south of Brisbane suffered.

A monsoonal trough brought cloudy, wet weather to a good portion of eastern Australia during January. At Mount Isa, in north Queensland, rain fell on every day of the month, nearly equaling their average annual total of 14 in. During the latter part of the month, tropical storm Wanda and a large extratropical system brought a week of heavy rains. At Brisbane, 25 in of its more than 34-in total fell from the 24th through the 27th. The previous January record was 27.7 in. The rains triggered floods.

In eastern Queensland, the Brisbane and Bremer Rivers overflowed their banks. At Ipswich, floodwaters from the Bremer were reported up to 25 ft deep along the main street. One-third of Brisbane, Australia's third largest city, was inundated on the 28th. The Brisbane River peaked at 19.7 ft. The port was forced to close for several days. The partially completed 62,000-ton oil tanker ROBERT E. MILLER broke its mooring and hit a dredge before running aground. A gravel barge broke loose and jammed against a pylon of the Centenary Bridge. Rail and air service, gas, electric, and water supplies were all interrupted. Damage was estimated at more than $20 million, and at least 10 people died in the floods.

In northern Queensland, the Gilbert, Norman, Saxby, Flinders, and Conclurry Rivers overflowed and merged into one gigantic sea. Pilots reported that the sea began about 150 mi inland and extended to the coast. The only distinguishing break between freshwater and seawater was the occasional roof of a house and cattle swimming among the treetops.

Flooding also occurred along the coast south of Brisbane. At the peak of the crisis, 8 ft of water covered the Pacific Highway at Chinderah. Farther south, levees saved Murwillumbah from serious flooding when the Tweed River rose to a 17-ft 8-in peak, 18 in below the 1954 record level.

SOUTH PACIFIC REGION

January through February is usually the heart of Southern Hemisphere tropical cyclone season. This January, tropical cyclone activity was confined to the South Pacific region (east of 100°E); four tropical storms and one hurricane plied these waters. In an average January, two tropical storms and one hurricane form in both the South Pacific and South Indian regions. Activity was similar in February. Three tropical storms formed in the South Pacific region, while just one developed in the South Indian Ocean. In a normal February, three tropical storms and a hurricane develop in the South Pacific, while two tropical storms and a hurricane roam the South Indian seas. Tropical cyclone activity is usually at a lull during January and February in the North Indian Ocean. This year was no exception. Tracks of the tropical cyclones are shown in figures 18 and 19.

Fiona formed just off the northwest coast of Western Australia on the 8th. She reached tropical storm strength on the 10th, while heading westward away from the continent. She evidently weakened and redeveloped on the 11th and was renamed Gwenda. The DOSINA encountered 40-kt southeasterlies some 300 mi southwest of the storm's center on the 12th. Later that day, Gwenda dropped below tropical storm strength.

A week later, on the other side of the continent, Nessie and Vera developed in the Coral Sea. Vera formed close to the York Peninsula, while Nessie popped up just northwest of New Caledonia. Neither storm became intense. The GSEF reported a 45-kt wind as she sailed close to Nessie's center on the 20th. The ORONSAY reported 40-kt winds near Vera's center on the 21st.

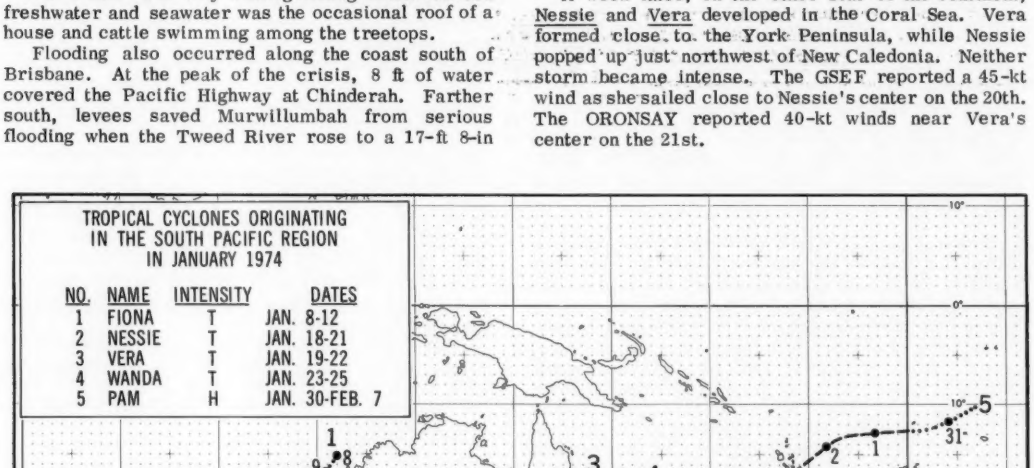

Figure 18.--Tropical cyclones, South Pacific Ocean, January 1974.

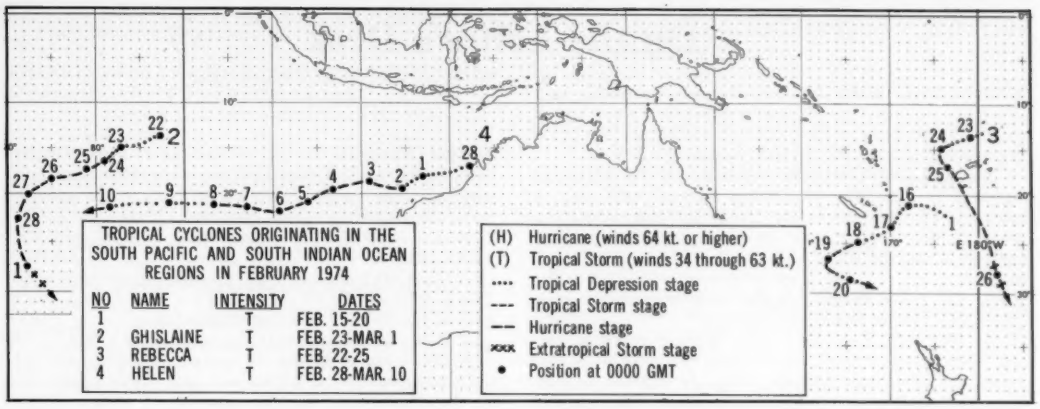
TROPICAL CYCLONES ORIGINATING IN THE SOUTH PACIFIC AND SOUTH INDIAN OCEAN REGIONS IN FEBRUARY 1974
NO NAME INTENSITY DATES
1 T FEB. 15-20
2 GHISLAINE T FEB. 23-MAR. 1
3 REBECCA T FEB. 22-25
4 HELEN T FEB. 28-MAR. 10
(H) Hurricane (winds 64 kt. or higher)
(T) Tropical Storm (winds 34 through 63 kt.)
Tropical Depression stage
Tropical Storm stage
Hurricane stage
Extratropical Storm stage
Position at 0000 GMT
E 180°W

Figure 19.--Tropical cyclones, South Pacfic and South Indian Oceans, February 1974.

In the wake of these two storms came Wanda, a short-lived tropical storm that figured more importantly in the Australian floods than as a sea threat. Wanda's maximum winds were estimated at 40 kt before she crashed ashore north of Brisbane on the 24th.

The really big storm of the month was hurricane Pam. She was first located east of the Dateline on the last day of the month. For the first week in February, she dominated weather in the seas between the New Hebrides, Australia, and New Zealand. During this period, she posed a severe threat to the flooded and rain-soaked coast of eastern Australia. Had Pam moved ashore, the results could have been disastrous. On February 1, Rotuma Island reported a 35-kt wind from the north, as the storm passed to the southwest. Pam reached hurricane strength on the 3d, before passing close to the northern tip of New Caledonia. Winds were estimated at 85 kt near her center on the 3d and 5th. Fortunately for Australia, Pam recurved. On the 6th, winds dropped below hurricane force; Lord Howe Island reported 40-kt winds as Pam passed within 100 mi. The following day, she completed an extratropical transformation.

In February, two storms developed east of Australia. An unnamed tropical storm plied the waters south of New Caledonia. It reached tropical storm strength briefly on the 18th and 19th. Then, on the 23d, tropical storm Rebecca formed north of the Fiji Islands. She brushed the islands with gale-force winds on the 25th.

On the 28th, Helen was spotted as a tropical depression just off Cape Leveque in Western Australia. From here, she started a long journey westward. Helen reached peak intensity on the 4th and 5th of March, when winds near her center were estimated near 40 kt; this was confirmed by an unidentified ship.

SOUTH INDIAN OCEAN

The only storm to ply these waters during this 2-mo period was a creature named Ghislaine. Her territory was near the borderline that separates the two regions. Ghislaine was a tropical storm from the 23d through the end of the month. On the 23d, the JOHAN U. encountered 30-kt winds about 300 mi north of the storm's center.

TROPICAL CYCLONE NAMES FOR AUSTRALIAN REGIONS AND PAPUA-NEW GUINEA REGION FOR THE 1974-75 SEASON

Australian Regions

Eastern (Brisbane)	Northern (Darwin)	Western (Perth)
Flora	Selma	Marcia
Gloria	Tracy	Norah
Helga	Wilma	Penny
Ina	Amelia	Robyn
Jill	Bessie	Shirley
Kate	Cheryl	Trixie
Lila	Della	Vida
Mandy	Esme	Amy
Nita		Beverly
Olive		Clara
		Denise
		Essie

Papua-New Guinea Region

Marmin
Nanaim
Ovaro
Peso
Ramale
Sasong
Tova
Varo

On the Editor's Desk

EXAMPLE OF SUPERSTRUCTURE ICING

The iced-over JOHN AND OLAF (fig. 20) was found aground in Jute Bay in Alaska, covered with ice, on January 17. The four-man crew had abandoned the 86-ft fishing craft (cover) in the Shelikof Strait south of Kodiak on the 16th. The U.S. Coast Guard said northwesterly winds up to 70 kt were reported in the area, and their vessels fought 30-ft seas in trying to reach the fishing vessel's position.

On the 17th, four men were sighted in a liferaft, but when the raft was later found about 50 mi to the south, the crew was missing. The air and sea search (fig. 21) continued for a week, without finding the crew.

The January 1974 issue of the Mariners Weather Log contained an article on superstructure icing. The marine forecasts issued by the Anchorage Weather Service Forecast Office include superstructure icing when air and sea temperatures and winds indicate icing is probable. The phrases LIGHT FREEZING SPRAY, MODERATE FREEZING SPRAY, HEAVY FREEZING SPRAY WITH RAPID ACCUMULATION OF ICE, AND VERY HEAVY FREEZING SPRAY WITH VERY HEAVY ACCUMULATION OF ICE are now a part of the marine forecast (table 13).

The hazard of superstructure icing is a fact of life in Alaska waters during the winter. In February 1974, the fishing vessel NORMAR was lost in the same area as the JOHN AND OLAF, because of icing. Fortunately, the Coast Guard was successful in rescuing the crew, even though there were problems with icing of the cable and basket from the helicopter.

Figure 20.--Ice covered JOHN and OLAF with its port side awash, lies aground in the clear waters of Jute Bay, Alaska. This stark topside view vividly shows the heavy accumulation of ice on some of the rigging. U. S. Coast Guard Photo.

Table 13.--Freezing spray and ice accumulation, guidelines for forecasts.

FREEZING SPRAY WITH SLOW ICE ACCUMULATION (Forecast: LIGHT FREEZING SPRAY)
Air temperature between 25° and 30°F.
Any wind speed.

FREEZING SPRAY WITH MODERATE ICE ACCUMULATION (Forecast: MODERATE FREEZING SPRAY)
Air temperature between 18° and 25°F.
Wind below 18 kt.

FREEZING SPRAY WITH RAPID ACCUMULATION OF ICE (Forecast: HEAVY FREEZING SPRAY WITH RAPID ACCUMULATION OF ICE)
Air temperature between 18° and 25°F and dew point below 15°F.
Wind 18 to 30 kt.

FREEZING SPRAY WITH VERY RAPID ACCUMULATION OF ICE (Forecast: VERY HEAVY FREEZING SPRAY WITH VERY HEAVY ACCUMULATION OF ICE)
Air temperature below 18°F.
Winds greater than 30 kt.

The following accumulation rates are based on ships in the 100- to 250-ton class:
SLOW ACCUMULATION of ice is defined as less than 1.0 tons per hour.
MODERATE ACCUMULATION of ice is defined as 1.0 to 2.0 tons per hour.
RAPID ACCUMULATION of ice is defined as 2.0 to 4.0 tons per hour.
VERY RAPID ACCUMULATION of ice is defined as more than 4.0 tons per hour.
Other criteria will probably be developed based on accumulation rate defined in terms of inches per hour, but are not available now.

ICEBERGS THREATEN NORTH ATLANTIC SHIPPING

More than 2,400 icebergs from Cape Freels, Newfoundland, north to Cape Dyer on the Cumberland Peninsula in Northern Canada, may present a poten-

Figure 21. -- The Coast Guard Cutter CITRUS is heavily coated by ice during its vain attempt to rescue the crew of the JOHN and OLAF. U. S. Coast Guard Photo.

tially serious threat to North Atlantic shipping, if wind and sea conditions move them much further south.

Almost 200 of the bergs, found earlier this year by planes of the U.S. Coast Guard's International Ice Patrol, were clustered above the 48th parallel. Those that move below the 48th enter the major shipping lanes and become a hazard to safe navigation.

Started in March--2 mo later than last year--the ice patrol began monitoring the movements of 82 icebergs which were off Newfoundland's east coast. Although the patrol started later this year, the potential number of icebergs that could drift into the shipping lanes is more than twice the normal yearly average. The normal yearly average, based on figures from 1946 to 1973, is 280. The flights this year also took in a larger area than in the past, as they attempted to get a better idea of the potential iceberg danger.

The weather has been the major factor in keeping the bergs above the 48th parallel until early April, as the winds needed to move them into the shipping lanes were not present. The number of bergs that move into the Grand Banks area varies from year to year because of this reason.

Icebergs drift according to the direction of the sea currents and are often encountered far beyond the normal polar regions. An iceberg is created or "calved" when a glacier enters the sea from the polar icecap and is pushed outward into water that is deeper than the thickness of the ice. The ends then break off, and the detached masses float away as icebergs. Only one-sixth of the berg is visible above the water and may rise more than 300 ft. As the bergs move southward and below the 48th parallel, they become exposed to warmer water and air temperatures. When they reach the Gulf Stream currents, their lifespan is shortened to a matter of weeks or even days.

Besides looking for bergs, the International Ice Patrol is also a major source of information on the waters of the North Atlantic. Information gathered by the organization, along with sightings reported by ships transiting the area, is fed into a computer every 12 hr, and the predicted positions of the icebergs are then transmitted twice daily from radio stations in the United States, Canada, and Europe. Through sampling, salinity measurements, and other aspects of oceanographic research gathered by the Coast Guard Cutter EVERGREEN, information is provided to researchers worldwide.

NEW COAST GUARD RULES REQUIRE EMERGENCY RADIOBEACONS

The U.S. Coast Guard has issued new lifesaving equipment regulations which will require certain vessels engaged in ocean or coastwise service to carry on board an Emergency Position Indicating Radio-Beacon (EPIRB). This newly required equipment is designed to send out a distinctive radio signal from a vessel in distress and will facilitate search and rescue operations.

The regulations further state that these emergency radiobeacons will be carried by the vessels in such a manner that should the vessel sink, the radio would float free and automatically activate the broadcast signal. They will also have to be stowed in a location that is easily accessible for emergency use and for the monthly testing required by the rules. The regulations will become effective on March 1, 1975.

Vessels engaged in ocean or coastwise service and affected by the regulations include the following classifications: inspected tank vessels, passenger vessels, cargo and miscellaneous vessels, and oceanographic vessels.

The only exemption to the rule will apply to a coastwise vessel which has a Certificate of Inspection endorsed for a route which does not extend more than 20 mi from a harbor of safe refuge, but then only if that vessel carries a radiotelephone on board that meets the FCC requirements for a VHF radio on that vessel.

The new rules do not apply to uninspected commercial vessels or to vessels that are defined to be boats under the Federal Boat Safety Act of 1971. These vessels, however, may be authorized by the FCC to carry EPIRB's when operating beyond the range of VHF distress coverage on the ocean. The Coast Guard encourages operators of such vessels to obtain authorization from the FCC and carry EPIRB's.

The marine EPIRB's will operate on both 121.5 and 243 MHz. These frequencies are now widely used for distress and emergency systems for the civil and military aviation communities. The misuse by maritime users would have an adverse effect on these existing systems. Therefore, a number of technical features have been included in the marine EPIRB's to reduce the possibility of inadvertent activation and false alarms. In addition, any person misusing the equipment or frequencies will be subject to punitive action by the Coast Guard or the FCC.

Complete details of the new regulations, which are amendments to Title 46, U.S. Code of Federal Regulations, appear in the March 18, 1974, issue of the Federal Register. Equipment and marking requirements, as well as transmitting frequencies, will be the subject of a Federal Communications Commission rule which appears in the March 18, 1974, edition of the Register. Copies of either may be obtained by writing: Executive Secretary, Marine Safety Council (G-CMC/82), 400 Seventh Street, SW., Room 8234, Washington, D.C. 20590.

This Coast Guard rule making is the culmination of an effort dating from 1957, when a study of an extensive air-sea/search effort determined the probability of location of survivors and the cost involved for both a visual and an electronic search using emergency beacons. Because the results showed a significant increase in the probability of survivor location and a decrease in search cost, the study recommended that seagoing vessels be required to carry emergency position indicating radiobeacons.

The Coast Guard carried this proposal to the 1960 SOLAS (Safety of Life at Sea) Conference. The SOLAS Conference recognized the need for EPIRB's and this recommendation was adopted by the final 1960 SOLAS Convention.

Since the 1957 study, several reports of Marine Boards of Investigation have noted the need for EPIRB's. Among these are the MARINE SULPHUR QUEEN, which disappeared with all hands in February 1963; the DANIEL J. MORRELL, which broke in two and sank with only one survivor in November 1966;

and, more recently, the TEXACO OKLAHOMA, which broke in two and sank with the loss of 31 lives in March 1971. Many other cases are on file which supported the need for such a device.

These cases indicate that many lives probably could have been saved through an early distress alert and that millions of dollars expended on search efforts could have been saved.

IMPORTANT CHANGES IN WEATHER BROADCASTS BY COAST GUARD RADIO STATIONS

Although included in the corrections to Worldwide Marine Weather Broadcasts, the following addition to weather broadcasts by Coast Guard Radio Stations are worth special attention:

Radio NMN, Portsmouth, Va., now includes the forecast for offshore waters 32°-41°N, west of 65°W (West Central North Atlantic Waters), in its daily 0120 and 1620 GMT CW broadcasts.

Radio NMA, Miami, Fla., includes the forecast for Southwest North Atlantic waters in its daily 0100 and 1600 GMT CW broadcasts.

Radio NMF, Boston, Mass., radiofacsimile transmission is now 1830 GMT instead of 1730 GMT.

VHRR RECEIVED AT SAN FRANCISCO

A very high resolution image from the NOAA-2 spacecraft (fig. 22)--one of the first received by new equipment at NOAA's San Francisco Satellite Field Services Station--shows the California coastline, Baja California, and weather systems over the Pacific Ocean. The r-shaped white area in California is fog over the San Joaquin Valley, and next to it is the snow-covered Sierra Nevada mountain range.

The San Francisco receiving equipment, now being checked and evaluated, will acquire three adjacent picture swaths twice daily when it becomes operational. The images, which have a resolution of 1/2 mi at the center, will significantly increase the weather information available to the National Weather Service Forecast Office at San Francisco and will be used in providing services to other interests, including shipping and fisheries.

The NOAA satellites and the Satellite Field Services Station are operated by the National Environmental Satellite Service.

INSTRUMENTED TOWERS USED IN NOAA GREAT LAKES RESEARCH STORED UNDERWATER IN WINTER

A new method has been devised for the winter storage of steel towers (fig. 23) used in the Great Lakes for research. They are placed at the bottom of a lake. The towers are kept in 40 to 50 ft of water until spring, when they are raised to the surface and put back to work.

The unique storage system was devised by the Lake Survey Center, the Detroit-based facility of the National Ocean Survey, an agency of NOAA. It was successfully tested in 1972-73. Now there are three towers

Figure 22.--The new San Francisco VHRR acquisition system shows storm clouds moving in on the Pacific Northwest while the southwest basks in sunshine.

Figure 23. -- Typical Lake Survey Center instrument research tower.

at the bottom of Lake Michigan and the Straits of Mackinac, which connect Lakes Michigan and Huron. When spring comes and the ice has gone, the towers will be brought to the surface and research resumed.

When in use, the towers are equipped with about a dozen instruments which provide data on surface and underwater temperatures; current speed and direction, both on and beneath the surface; barometric pressure; and wind speed and direction. The research is being conducted by the Lake Survey's Limnology Division.

The research program has been underway since 1962. The previous practice was to float a tower ashore, using air-filled 52-gallon drums, take it apart, and transport it back to Detroit for storage. It was a 2- to 3-day job, with the same amount of time required to reset the tower in the spring with its instruments.

A Lake Survey technician and scuba diver suggested that the towers be stored at the bottom of the lake. It was first tried in the fall of 1972, a tower being dropped into 50 ft of water off Muskegon in Lake Michigan. The following spring, the tower was brought to the surface and re-erected without any trouble. The water was too deep for the tower to be affected by ice, and, because it was made of galvanized steel, little or no rusting occurred. Some sand accumulated around the tower, but most of it was still visible to the scuba divers.

It takes a half day or less to drop a tower. The guy wires on one side are disconnected and the tower is allowed to fall over into the water. To raise a tower in the spring, two lifting bags are attached to the tower. These are large air-filled, open-bottomed canvas and plastic tentlike devices. Each is capable of lifting 1,000 lb. When the towers are returned to the surface, they are placed again in a vertical position, guy wires are reattached, instruments installed, and they are back in business.

One tower is now stored at the bottom of Lake Michigan off Muskegon. It is held in place by a triangular metal base and guy wires attached to 6-ft-long anchors which are screwed into the lake bottom. Two towers recline horizontally on the bottom of the Straits of Mackinac, about 1 mi from shore between Mackinac and St. Ignace. Since the bottom here is mostly rock, the guy wires are attached to 7,200-lb concrete blocks, six to a tower. The Coast Guard assisted in placing the blocks. It was estimated that the new method resulted in a saving of $1,100 per tower.

The Lake Survey Center prepares and publishes navigational charts and related materials, studies lake levels and river flow, provides consulting services to international bodies that govern the joint use of the border waters, and conducts scientific investigations of coastal engineering and water resources. The Lake Survey's activities include the Great Lakes and navigable waters of the New York State Barge Canal System, Lake Champlain, and the Minnesota-Ontario Border Lakes.

RECORD-BREAKING DEEP OCEAN BUOY SILENCED AFTER FOUR YEARS OF REPORTING WEATHER INFORMATION: ANCHORED IN ATLANTIC

An unexplained incident at sea has silenced a large environmental buoy which has been keeping tabs for almost 4 yr on ocean-spawned storms that could endanger the mid-Atlantic States and New England. It is not known whether the buoy suffered damage from a passing ship or whether the damage was the result of age in the 15-yr-old buoy.

The 100-ton buoy (fig. 24) is anchored in the Gulf Stream in 9,900 ft of water, about 125 mi east of Norfolk, Va. The automatic data-reporting buoy (designated EB-01 for Environmental Buoy Number 1) ceased all transmissions on March 6. Two passing Navy ships subsequently reported the buoy had suffered severe damage.

The buoy is one of five large experimental buoys off the Atlantic, Gulf of Mexico, and Pacific coasts that provide environmental data from the deep ocean. In view of the extensive damage reported, the NOAA Data Buoy Office, which manages the program, planned to recover the buoy and tow it to the Portsmouth, Va., Coast Guard Base for damage assessment.

The buoy has established a record of longevity in the deep sea for a device of its size and complexity. It was operationally deployed in the Atlantic February 1, 1970, and has since been refitted on two occasions with new and improved components and sensors.

In the 4-yr period of its deployment, the buoy was one of the prime sources of data that revealed the formation of more than 50 major storms off the mid-Atlantic and New England coasts.

The buoy was programed to check all its sensors

Figure 24.--Large experimental buoy dwarfs men working aboard. EB-01 was silenced after an unexplained accident.

once each hour, record the acquired data, and transmit the stored data every 3 hr to the Coast Guard Radio Station, Miami, Fla. The data were then transmitted to NOAA's National Meteorological Center in Suitland, Md., via landline and then disseminated worldwide via the regular weather networks. During its time on station, the buoy was interrogated by Miami Radio on numerous occasions during severe weather conditions.

NAMES FOR TROPICAL CYCLONES, 1974

The following list of names are those that will be assigned to tropical cyclones that reach tropical storm or greater intensity during calendar year 1974. A new list is started each calendar year for tropical cyclones of the eastern North Pacific (Central America west coast to 140°W) and of the North Atlantic (including the Caribbean Sea and the Gulf of Mexico). For the western North Pacific (140°W to the Asiatic mainland), the practice of continuing the alphabet from the previous year will remain unchanged.

Atlantic	Eastern Pacific	Western Pacific	
Alma	Aletta	Wanda	Agnes
Becky	Blanca	Amy	Bess
Carmen	Connie	Babe	Carmen
Dolly	Dolores	Carla	Della
Elaine	Eileen	Dinah	Elaine
Fifi	Francesca	Emma	Fay
Gertrude	Gretchen	Freda	Gloria
Hester	Helga	Gilda	Hester
Ivy	Ione	Harriet	Irma
Justine	Joyce	Ivy	Judy
Kathy	Kirsten	Jean	Kit
Linda	Lorraine	Kim	Lola
Marsha	Maggia	Lucy	Maggie
Nelly	Norma	Mary	Nina
Olga	Orlene	Nadine	Ora
Pearl	Patricia	Olive	Phyllis
Roxanne	Rosalie	Polly	Rita
Sabrina	Selma	Rose	Susan
Thelma	Toni	Shirley	Tess
Viola	Vivan	Trix	Viola
Wilma	Winona	Virginia	Winnie
		Wendy	

AWARD TO COOPERATIVE MERCHANT MARINE RADIO OFFICER

Anton B. Anderson, of Yucca Valley, Calif., was honored with the U. S. Department of Commerce, National Oceanic and Atmospheric Administration "Public Service Award," in recognition of service contributing to the Public Safety and Welfare performed for the National Weather Service.

Mr. Anderson, a merchant ship Radio Officer, was recognized for 44 yr of work in the voluntary merchant vessel cooperative weather reporting program. Since 1929, he has transmitted regular weather reports to the National Weather Service, and to meteorological services of other nations throughout the world, from the many U.S. merchant and government ships on which he has served.

The award was presented on February 21, 1974, at the San Francisco headquarters of the Pacific Weather Project of the National Weather Service, by Paul A. Arnerich, Marine Supervisor, in behalf of Dr. George P. Cressman, Director of the National Weather Service (fig. 25).

Figure 25.--Anton Anderson (right) receives his "Public Service Award" from Port Meteorological Officer Paul A. Arnerich for transmitting radio weather messages for over 44 yr.

Anton B. Anderson came to the United States from Sweden in 1924. He says that on this, his first transoceanic voyage, he lost, among other things, his Swedish accent, but did not, however, lose his fascination with the sea.

In 1927, he received his first radio operator's license, granted and signed by then Secretary of Commerce, Herbert Hoover, who was elected President of the United States in 1928.

In 1927, Mr. Anderson went to sea, his first assignment being in a ship in the energy transportation service, the collier MAURICE TRACY, which was engaged in hauling coal from Hampton Roads, Va., the world's largest coal shipping center, to fuel distributors and users in cities of the eastern seaboard.

He first sent ship's weather reports in 1929, while Radio Officer of the YORO, a banana boat operating between Kingston, Jamaica, and New York City for the Standard Fruit and Steamship Company of New Orleans. His weather reports were transmitted to shore radio stations in Miami and Palm Beach, Fla., Guantanamo Bay, Cuba, and Kingston, Jamaica, from which points they were relayed to Weather Bureau headquarters in Washington, D.C.

In those days, ships' weather reports were, for the sake of brevity and economy, composed in groups of 5-letter code words, from weather observations made by the ships' deck officers. In this code, information concerning several items of weather observation data could be compressed into one short word. A 5-letter word such as "Peter, Robin, Tiger, etc." conveyed information concerning the state of the weather and direction and force of the wind; for example, "Weather: raining, wind from the northwest at 18 knots." Additional code words conveyed other weather observation data such as barometric pressure, temperature, cloud forms and movement, etc. In today's computer

age, this old word code has been superseded by numerical codes compatible with computer processing of the data and with automatic transmission of weather data in international exchange systems. Ships' weather reports in the new digital code can be transmitted to shore radio stations and relayed almost directly into a computer in Washington and sent on to other weather forecast centers in the Nation and the world.

Mr. Anderson recalls that in 1932, when he was Radio Officer in the tanker W. C. TEAGLE, bound from Montevideo to Aruba, he received a message from the German dirigible GRAF ZEPPELIN, requesting weather reports from ships along her route. He sent several reports to the dirigible until she was out of radio range, on her return trip to Germany from Rio de Janeiro.

It is of interest, in this day when the subject of energy is so much in the news, that the major part of Mr. Anderson's sailing career, during which he sailed as Radio Officer on 70 different ships, was spent in the fuel transportation field, mostly in tankers. During the period 1930-51, including World War II, he was in the ESSO (Standard Oil of New Jersey) fleet. He has since served in ships of the U.S. Navy's Military Sealift Command, Chevron (Standard Oil of California), and Atlantic-Richfield tanker fleets.

A great many of the ships in which Mr. Anderson served were or are at present part of the National Weather Service's Cooperative Ship Program, participating in the worldwide merchant ship marine weather reporting program of the World Meteorological Organization (WMO). In this program of the WMO, part of the work of the United Nations, over 7,000 ships of 40 maritime nations regularly make weather observations while at sea and transmit them to designated shore radio stations. The reports are relayed to centrally located collection centers operated by the cooperating nations, and, within just a few hours after they are made, the observations are delivered to weather forecast centers all over the world by computer-operated distribution systems.

In Mr. Anderson's citation, Dr. George P. Cressman, Director of the National Weather Service, said, "Although many changes have taken place in weather analysis and forecasting in the 44 yr since you began your service, the weather reports from ships on the high seas still contribute greatly to our ability to describe and forecast ocean conditions. The dedication and enthusiasm of men like yourself is the reason for the success of the cooperative ship weather observing program."

OCEAN DUMPING REGULATIONS ENFORCED BY COAST GUARD

During 1974, some five billion gallons of sludge, dredge spoils, acid wastes, and debris are expected to be dumped in the Atlantic off Long Island and New Jersey, at points as close as 10 to 30 mi off New York Harbor and Delaware Bay, and as distant as 100 mi or more from Atlantic City, N.J., and New York City.

Although this is a projected figure, the Third Coast Guard District's environmental office on Governors Island, N.Y., believes it is a good one, based on the dumping figures kept there over the last 6 mo of 1973. Those figures show that almost 2.5 billion gallons of wastes were barged into the Atlantic and dumped--most of this originating in the metropolitan New York City-New Jersey area. Other wastes came from different parts of New Jersey, as well as from the Philadelphia, Pa.,-Camden, N.J., sector.

The dumping is regulated by the "Marine Protection, Research, and Sanctuaries Act of 1972," which is administered by the Federal Environmental Protection Agency (EPA). The eventual aim of the act is to end ocean dumping as new disposal methods are developed--although no firm timetable for this is given. The job of taking the dumping regulations to sea and enforcing them is assigned to the U.S. Coast Guard.

The EPA administers the law through a system of dumping permits and continuing research. Among other things, the act restricts how much and what kind of materials may be dumped at sea. As part of the permit application procedure, EPA requires dumpers to explore alternate means of disposal. It also permits the Secretary of Commerce to designate "marine sanctuaries" where all dumping is prohibited, and sets up a continuing research and sample-gathering program to monitor and study the total effect of dumping on marine ecology.

For the Coast Guard, "taking the law to sea" means mainly surveillance. Helicopters regularly fly over dump sites, and patrols by Coast Guard cutters through the sites keep track of vessels which are dumping. Cutters also escort tugs and refuse barges out to the sites and, whenever required, Coast Guardsmen ride the tugs and barges themselves.

Of the more than 50 dump sites off the Atlantic, stretching from New England south to the Gulf of Mexico, 8 are located in 3 mid-Atlantic coastal regions. One region is off Delaware Bay and covers more than 1,600 sq mi of ocean, beginning about 30 mi east of Cape May, N.J.

Only neutralized acids, industrial salt wastes, and arsenic solutions can be dumped at this site. From July to December of last year, almost 163 million gallons were disposed of.

The second region is some 10 to 20 mi southeast of New York City, clustered in a 6-1/4-sq-mi area around Ambrose lighttower. Such wastes as dredgings, sludge, dirt, and waste acid are dumped there. During the same 6-mo period last year, more than 2.3 billion gallons were dumped there.

The third region, located 126 mi southeast of New York City or 95 mi due east of Atlantic City, N.J., covers more than 600 sq mi of ocean. This is the dumping ground for toxic chemical wastes. During the last 6 mo of 1973, more than 52 1/2 million gallons were deposited there.

The act specifically bans the dumping at sea of radiological, chemical, or biological warfare agents, as well as high-level radioactive wastes.

Although the entire program is EPA controlled, permits for dumping dredge spoils are issued by the Army Corps of Engineers, and all other permits are issued by the EPA. Once a permit is issued, a copy goes to Third District Headquarters. From there, the surveillance task is assigned to either the Coast Guard's Captain of the Port Office in New York Harbor or at Philadelphia, Pa., depending on the port from which the dumping vessel departs.

Permits may be issued for up to 3 yr, however, in each dumping incident, the dumper must first notify

the Captain of the Port Office of which dump site he will be using, what he intends to dump, and when.

It has been found that not notifying the Captain of the Port Office is the most frequently found violation. Violation reports are sent on to EPA for resolution, and strong civil and criminal penalties are provided, ranging up to $50,000 fine or imprisonment for up to a year. Last year six concerns were alleged to have committed dumping violations, and these cases are now at EPA.

The masters of tugs and barges must also submit reports to the Coast Guard and EPA after the dump, showing where and when the dump was made. To detect violations, these are compared against Coast Guard sighting reports and the known time that it takes to travel to a dump site.

For the Coast Guard, surveillance is only a part of the job. The rest is research. EPA scientists regularly ride patrolling cutters into the dump sites, taking water samples and collecting other data for analyses. A more ambitious plan is an extended research cruise aboard a larger cutter. The cutter would serve as a platform at sea for the scientists, as they gather samples from the water, the bottom, and of the vegetation. These samples would be taken all along the transit routes to and from the dump site--as well as from the site itself. One such trip was planned for March and two others later this year.

The analyses of these data may, in some instances, cause EPA to relocate certain dump sites.

LETTERS TO THE EDITOR

The editor was asked to publish the following letter to all ships' masters from the National Weather Service Marine Program Manager. Also, do not forget to mail in or give the Port Meteorological Officer the original copy of all weather observations, as they become a valuable part of the world climatic archives.

TO MASTERS OF COOPERATING VESSELS

Recent decreases in the number of active merchant ships and in shipping activity have resulted in a deficiency of ship weather observations. These deficits have been severe in coastal waters and within 200 mi off the coast. Good analysis, forecasts, and warnings are dependent on adequate and representative data input to the processing systems. Mariners are requested to make a special effort to observe and transmit weather reports from these waters.

Since weather conditions over the water often differ from those at nearby coastal points, observations should be made even when close to shore. Ships operating in coastwise trade, or on coastwise legs of ocean voyages, are asked to make and transmit as many of the scheduled 0000, 0600, 1200, and 1800 GMT weather observations as possible. Also, vessels departing or approaching the coast on offshore voyages are requested to commence or continue scheduled observations as close to port as possible.

Cooperating vessels which act as observing ships for a government meteorological service other than the U.S. National Weather Service should not interpret this letter as a change to instructions furnished by their own government. The U.S. National Weather Service is grateful to such vessels for all possible cooperation compatible with instructions of their own meteorological services.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

MARINE WEATHER REVIEW

Smooth Log, North Atlantic Weather

November and December 1973

The SMOOTH LOG (complete with cyclone tracks [figs. 26-29], climatological data from U. S. Ocean Station Vessels [tables 14-16 and 18] and gale [tables 17 and 19]), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

SMOOTH LOG, NOVEMBER 1973--Only in the overall pattern did the storm tracks compare with the climatological mean tracks; that is, they were southwest to northeast. The mean track across the United States was further south; a primary track just off the United States east coast toward Newfoundland did not exist; a secondary track slightly west of midocean was a primary track and more northerly; the primary track south of Greenland and over Iceland curved east-southeastward into the Baltic Sea, rather than off the Norwegian coast.

Since the mean cyclone tracks and the mean pressure pattern have a direct relationship, the mean pressure pattern would almost necessarily differ from the climatological mean, with large anomalies. This was the case.

The 1000-mb Icelandic Low was near 55°N, 57°W, some 800 mi southwest of its 1001.8-mb climatic position. The 1020.7-mb climatological Azores High was the 1025-mb Bay of Biscay High this month, just west of Bordeaux. A trough stretched southeasterly from the mean Low toward the Azores, where the climatic High would normally be. A closed 1021-mb High was located over the southeastern States and bulged eastward over the ocean. A large 992-mb Low was centered east of Murmansk and dominated Eurasia north of 50°N. Interestingly, the Asian High was normally located and 4 mb higher in pressure; thus, the gradient around the Low was very tight.

The anomaly chart was a mass of concentric circles. A minus 9-mb anomaly was located just south of the mean Low over Belle Isle. A minus 19-mb departure was centered over the entrance to the White Sea. The largest positive anomaly was 17 mb, centered over central Greenland. A plus 11-mb center was west of Ireland, about 54°N, 18°W, and a plus 4-mb centered about 550 mi east of Miami. The trough, southeastward out of the so-called Icelandic Low, was reflected by an anomaly trough along the same line.

November is the end of the tropical cyclone season, except for two which have occurred in December during the last 43 yr. During that period of time, 16 have occurred during November, with 7 developing into hurricanes. There were none this month.

This storm came out of the Great Lakes on the 1st. At 1800, three ships on Lake Huron reported measuring winds of 42 and 43 kt. They were the PAUL H. CARNAHAN, off Harbor Beach with 5-ft seas, the WILLIAM A. IRWIN, near Mackinac Island, with 5-ft seas, and the JOHN SHERWIN, off Oscoda with 6.5-ft seas. By 0000 on the 2d, it was near the Bay of Fundy, with a pressure of 973 mb. The strong winds were behind the cold front and mostly on the back side of the trough just off the coast. The WALTER HERWIG, at 42.5°N, 68.5°W, was pounded by 50-kt and 16-ft seas, as was the AMERICAN LEGEND, with 20-ft seas. The PJSU found 45-kt gales, and the STOLT LLANDAFF and the USCGC TANEY had 40-kt gales. Twelve hours later, the GULF HANSA was taking 50-kt winds and 36-ft seas on her port side, 120 mi southeast of Cape Sable. At 1800, the AMERICAN LEGACY was headed into westerly 55-kt storm winds, about 250 mi south of Sydney, Nova Scotia, with 25-ft seas and 41-ft swells. Six hours later, the winds had decreased to 45 kt, with 21-ft seas and 33-ft swells.

On the 3d, the 974-mb storm moved north-northeastward and, at 0000 on the 4th, was near Goose Bay, Labrador. SEDCO J measured a howling 60-kt wind. The PAVLOVO, over the Sable Island Bank, was lashed by 50-kt winds and 23-ft seas. Inside the Gulf of St. Lawrence, VGBZ was swept by 60-kt storm winds and, in the short fetch, 18-ft seas. Gale winds were blowing as far as 1,000 mi south of the center. For over 36 hr, Ocean Station Vessel "B" suffered winds of 45 to 50 kt. The LEON FALK, JR. found 42-kt winds on eastern Lake Superior, with 13-ft seas, on the 6th.

The LOW was moving slowly up the Labrador coast and the gradient weakening. Several LOWs with frontal waves had moved around its edge. The central pressure was slowly rising as it drifted in the Labrador Sea. About the time of the passage of the cold front trailing from one of these waves, the LASH TURKIYE was buffeted by 55-kt winds.

This was the LOW that absorbed the previous storm. At 1200 on the 8th, it was a 1000-mb cyclone, just south of James Bay. Lake Superior was being swept by northwesterly winds of over 40 kt. The ASHLAND, CASON J. CALLAWAY, and the PAUL H. CARNAHAN suffered temperatures of -4° to -6°C and 8- to 16-ft seas. At 0600 on the 10th, it moved through the

Strait of Belle Isle and was a 976-mb storm. The C. P. DISCOVERER, near 53°N, 50°W, was rocked by 45-kt gales. Off Cape Race, a ship reported 55-kt winds from the south prior to frontal passage.

On the 11th, the LOW was 970 mb and moving up the Davis Strait. Ocean Station Vessel "B" was getting no respite, as she measured 50- and 60-kt winds until 1200 on the 12th. Kap Farvel had a blizzard going on, and the NORMAN MCLEOD ROGERS, off Hebron on the Labrador coast, had 45-kt northwesterlies. Ships were reporting 35- to 45-kt gales over 700 mi to the southeast. The LOW split into two LOWs as it moved past Kap Farvel, with the LOW in the Denmark Strait being the most vicious. At 0000 on the 12th, the BJARNI SAEMUNDSSON, at 65.6°N, 31.6°W, was engulfed by 60-kt winds and heavy snow. At 1200 on the 12th, the Davis Strait LOW had dissipated and the Denmark Strait LOW was racing eastward. Forty- to fifty-knot winds were still the order of the day. A Danish coastal station reported 40-kt winds. At 0000 on the 13th, the LOW was near Bergen, Norway, and Stavanger reported 40-kt, and a Netherlands coastal station felt a 45-kt maelstrom. At 1200, the station reported 50 kt. The LOW moved into northern Russia, where it stalled near the White Sea, to be reinforced later by other LOWs.

This was a short-lived LOW, which formed east of Bermuda, near 34°N, 58°W, on the 11th. Gale winds were reported on the west side, with its inception. At 0600 on the 12th, the OLGA MÆRSK, at 34°N, 57.7°W, was swept by 60-kt winds. No seas were recorded. At 1200, the pressure had dropped to 1002 mb, near 39°N, 54°W, and the KANAGAWA MARU, which was less than 100 mi northwest of the center, was buffeted by 50-kt winds and 23-ft seas. At 1800, the ATLANTIC FOREST measured 50-kt northerly winds west of the center, with 14.5-ft seas and 19.5-ft swells. As it moved northeastward off the Grand Banks, the drilling rigs were lashed by 40-kt gales. SEDCO I reported the worst lashing of 45 kt, at 1200 on the 13th. For some reason, the LOW then was filling rapidly and dissipated on the 14th.

An upper-air trough was over the southern part of the central Atlantic at this time. This was reflected at the surface by a series of waves forming on the front that was associated with the previously described LOW. At 0000 on the 15th, a 999-mb LOW center formed near 27°N, 45°W. The NORTHERN STAR was on the 1000-mb isobar and very near the center. She reported heavy rain and 35-kt winds. The storm was moving northward and, at 0000 on the 16th, was near 31.5°N, 40°W. The MEDEA, at 30.9°N, 40.9°W, was about to pass through the center with 40-kt winds, as the LOW took an easterly course. Twelve hours later, several other ships were feeling the storm's wrath, as it increased in size. The FRIESENSTEIN was to suffer the worst, with 50-kt westerlies near 27.5°N, 39.8°W. Northwest of the center, the ALEMANNIA combated 45-kt gales and 20-ft seas. At 0000 on the 17th, the 992-mb LOW was moving due east. The CITY OF OTTAWA was headed into 40-kt winds, southeast of the center.

The LOW was now stacked vertically, with an upper-air cutoff LOW, and drifting eastward, while gradually filling. The gradient would no longer support gale-force winds, but the cyclonic circulation persisted until the 24th.

Monster of the Month--A high-pressure center moved eastward out of the United States midwest. On the 19th, it split into two centers, one over Georgia and one east of Bermuda. To the north, a small LOW developed off the New Jersey coast. Frontogenesis quickly occurred, as multiple waves moved eastward. These were shallow and difficult to trace from one chart to another.

By 1200 on the 21st, one had developed to 994-mb near 39°N, 49°W. The LASH TURKIYE, near 38°N, 59°W, found 45-kt gales. The SIRARA and SUGAR CRYSTAL, almost equidistant northwest and southeast of the center, were buffeted by 35-kt gales. This LOW was caught up in the northeastward flow of the upper-air trough and dashed off to the north-northeast. At 1200 on the 22d, the CRYSTAL SAPPHIRE, near 49°N, 44.5°W, and only about 100 mi from the center, was beaten by 50-kt winds.

In the meantime, another center had developed near 32°N, 49°W. The EXPLORER was immediately caught in heavy, continuous rain, blown by 45-kt winds.

This new LOW became the center of attention, as it developed and the other scooted across the top of ridge to bring 40-kt winds to the coasts of the Low Countries. On the 24th and 25th, I found no reference to damage, but there must have been flooding along those coasts, as the winds persisted out of the northwest for many hours.

Meantime, back on the 23d, the 984-mb LOW was generating gale winds from 30° to 45°N and 35° to 55°W. The POSSEHL, at 34.3°N, 49.1°W, lucked out with 45-kt gales and 20-ft seas and swells. The worst was yet to come. The Greek motorvessel KARINA anchored off Flores Island, Azores, late on the 23d, after a cargo of steel plates shifted. Plates were resecured on the 25th, but moved again on the 27th, after encountering heavy seas.

Twelve hours later, at 0000 on the 24th, the LOW was at 41°N, 43°W, and moving northward. The DOCTOR LYKES, near 42°N, 46°W, and SEDCO J, at 47°N, 48.7°W, both were ravaged by 65-kt hurricane-force winds. The PHOTINIA, 360 mi west of the center, was pounded by 50-kt winds. A U.S. Coast Guard cutter also measured 50-kt winds. The seas were running about 15 ft, but were reported as high as 20 ft in the southern quadrant. At 0600, the DOCTOR LYKES measured roaring 70-kt hurricane-force winds out of the west-northwest, and, at 1200, she was still being rolled by 65-kt winds on her starboard side as she continued her southwesterly course. The AMERICAN ALLIANCE, near 42.5°N, 41.5°W, had 29.5-ft seas. The ATLANTIC MONTREAL, 220 mi south of the center, was battered by 50-kt winds, as was another ship off Cape Race.

The LOW was now moving north-northwestward, and, at 1200 on the 25th, was at 49°N, 50°W. Thirty-five- and forty-knot winds were reported in all quadrants.

The storm was not dead, although it was weakening. The pressure had risen to 984 mb as it passed close to Ocean Station Vessel "B" at 1200 on the 26th. During the last 24 hr, the KOPER reported 50-kt

storm-force winds near 47°N, 42°W; Ocean Station Vessel "B," 40-kt winds and 23-ft seas; and Kap Farvel buttoned down for 50-kt freezing winds, which later increased to 65 kt.

The LOW survived until 1200 on the 27th, when it was east of Hopedale. At that time, another LOW, which had moved out of Maine on the 25th and swept south of Newfoundland, turned northward. As nature decrees, the young replaced the old.

This new 985-mb LOW was near 52°N, 45°W, at 1200 on the 27th, and had no more mercy than the old. Kap Farvel was still measuring 55-kt winds. The OYOR, 100 mi to the south, was whipped by 60-kt winds and 33-ft seas. South of Argentia, the FNBA was battered by 45-kt gales. The area south of the tip of Greenland remained an area to avoid. Kap Farvel continued to report 50-kt winds until after 0000 on the 29th. The SVENDBORG, 50 mi south, was torn by 60-kt winds. On the 29th, a LOW moving up the St. Lawrence valley stole the circulation.

Casualties--The old culprit fog was involved in the collision of the 11,474-ton Malaysian BUNGA ANGSANA and the 11,535-ton Greek IKAROS in the River Scheldt on the 3d. The Brazilian NETUNO (7,759 tons) arrived at Montreal on the 9th with heavy weather damage. The 27,029-ton British motorvessel ATLANTIC CITY dragged anchor during heavy weather at Rotterdam on the 16th, and collided with the Singapore-registered MAHINDA (10,950 tons). The 1,555-ton BOWSTREAM and the Dutch sand barge KRAMMER collided in fog in River Oude Maas on the 21st. While at anchor off Ashdod, Israel, the Cypriot ENETTE (2,487 tons) dragged anchor in heavy seas on the 23d, struck a breakwater, broke up, and sank. Eight bodies were recovered, and 13 people were reported missing. The 2,526-ton Cypriot ARMAS ran aground in heavy seas on the French coast, on the 26th. Abandoned by the crew, with one member missing, the vessel was since reported breaking up in gales.

SMOOTH LOG, DECEMBER 1973--The traces of the centers of the extratropical cyclones this month were very close to normal. The number of storms was below normal. As is usual, the origin over North America was diffuse, but two favorite paths stood out. One was over the Great Lakes toward Labrador, then dividing through either the Davis Strait or Denmark Strait. The other was along the United States east coast toward Newfoundland and on toward Iceland. There were several centers that toured the Mediterranean Sea and cyclone centers in the south-central part of the ocean that the climatological track charts do not indicate.

The mean sea-level pressure chart pattern appeared normal only across the 50° to 60°N parallel band, and there the pressure values were above normal. The main low-pressure center (Icelandic Low) was shifted many miles to the east, near 70°N, 10°E, at 993 mb. Climatology locates it near 62°N, 35°W, at 1000.7 mb. Another low center was over the Labrador Sea, near 62°N, 55°W, at 1004 mb. Between the two Lows, a high-pressure ridge bulged southward from northern Greenland over the Denmark Strait. The center of the Azores High was located near its normal position of 35°N, 33°W, at 1025 mb, compared to a 1021.1-mb climatic pressure. The 1020-mb isobar, which usually covers the area of 30° to 40°N and 20° to 50°W, encircled most of the ocean area from Newfoundland to Cape Finisterre to Cabo Bajador to Florida. The pressure over the eastern United States was very flat, averaging about 1019 mb. A 1015-mb Low was centered in the Mediterranean Sea near Sardinia. Very straight zonal flow stretched from Labrador into central U.S.S.R. between 50° and 60°N.

The anomaly chart was very complicated. The major anomaly centers were as follows: a large negative 14 mb over central U.S.S.R., with a secondary negative 12 mb just off the Norwegian coast near Bodø; a negative 2 mb over Baffin Bay, with a positive 10 mb over northeastern Greenland; a positive 11 mb over western Hudson Bay; a positive 9 mb east of Newfoundland, near 48°N, 48°W; and a positive 8-mb center in midocean, near 52°N, 37°W. The isolines surrounding these centers made a complicated pattern.

With the complex pressure and anomaly patterns, it is a wonder that the storm tracks paralleled the climatological pattern as closely as they did. There were no tropical cyclones this month.

This first LOW of the month formed on an Arctic front, after it had moved many miles over the ocean, near 40°N, 50°W, at 1200 on the 2d. It moved southwestward and deepened, dropping to 994 mb by 1200 on the 3d. The IVERNESS, about 300 mi southwest of the center, found 50-kt winds and 16-ft seas. The ETHA and the FARMSUM were buffeted by gales to 45 kt on the west side of the LOW. The SEA LAND MARKET, sailing west-southwestward, encountered 48-kt gales and seas as high as 29.5 ft, in the vicinity of 41°N, 42°W, between 1200 on the 3d and 1200 on the 4th.

At 1200 on the 4th, the 986-mb LOW was at 38°N, 49°W, with gale winds reported in all but the southeast quadrant. The IVERNESS was still being pounded by 50-kt winds. The LOW had slowly circled almost back to its inception point. The FARMSUM had slowed on its northeastward track, while fighting the 45-kt winds and 20-ft seas. The surface LOW was stacked almost vertically with an upper-air LOW, but, on the 6th, the upper-air LOW was breaking away from the main circulation to become a cutoff LOW. As this happened, the storm lost its dynamic support and began to fill, while drifting southward.

The surface LOW continued its southward movement to about 22°N, 42°W, at 0000 on the 10th, when it turned northeastward and dissipated on the 12th. It took one last swipe at shipping on the 11th, when the BREITENSTEIN was hit by 50-kt winds driving 13-ft seas and 16-ft swells to the northwest of the center.

This storm originated as a 1014-mb LOW on a front off South Carolina. It moved north-northeastward up the coast along the Gulf Stream, but didn't really start developing until the 11th off Cape Hatteras. At that time, a U.S.S.R. research vessel was at 37.8°N, 67.1°W, and was rolled by 40-kt winds and 26-ft seas from the south on her portside.

For the next 60 some hr, the LOW continued up the coast, passing over the Gulf of St. Lawrence on the 12th. Reports of isolated gale-force winds accom-

panied it on the journey. By 0000 on the 14th, the 989-mb center was over the Labrador Sea, and, at 0600, split into two centers on the tip of Greenland. The main LOW moved into Baffin Bay, treating shore installations to 40- and 45-kt winds. On the 15th, it died near Thule.

The eastern center continued deepening and moved across Iceland. The center passed almost directly over Ocean Station Vessel "A" and, at 0000 on the 15th, hammered her with 60-kt winds and 30-ft seas. Keflavik had 45-kt southerly winds, which 12 hr later had shifted to 40-kt northerly winds. Ocean Station Vessel "I" had 40-kt gales, over 300 mi to the south, and was pounded by 20-ft seas. As the LOW continued eastward, 40- and 45-kt winds were felt on all sides, including Ocean Station Vessel "M." The coastal areas of Ireland, England, and the North Sea countries took a beating, as westerly and northwesterly winds pounded water on their shores. The storm moved inland near Oslo on the 17th and continued into Finland.

Monster of the Month--Several LOWs developed in an area of weak gradient northeast of Bermuda on the 13th. These consolidated into one 1004-mb LOW on the 14th. The LAPLAND was near the center and reported a 65-kt wind. This report could have been an error in transmission or connected with a thunderstorm, as the weather was missing, but other ships reported cumulonimbus clouds in the area. The LOW rapidly developed a good circulation, and the MORMACTRADE was lashed by 45-kt winds. The LOW moved northward and weakened, and was almost absorbed by another LOW over Nova Scotia at the time. The warmer waters of the Gulf Stream regenerated the storm and it took an easterly track, still not being of much concern to ships.

At 0000 on the 18th, it was a different matter, though, as Ocean Station Vessel "C" found itself engulfed in 50-kt winds and 15-ft seas. At 1200 on the 18th, the central pressure had dropped to 973 mb, near 51°N, 21°W. The OLENEGORSK was at 49°N, 29°W, when she was ravaged by 65-kt winds and 36-ft seas. Twenty-four hours earlier, she had been placidly cruising with smooth seas and a 15-kt breeze. The NOVGOROD, about 180 mi to the southeast, was whipped by 45-kt winds, 26-ft seas, and 20-ft swells. The STAGHOUND, which was at 48°N, 25.4°W, at 1800, was beaten by 50-kt winds and seas of 29.5 ft. As the LOW passed to the south, Ocean Station Vessel "J" battled 50-kt winds and 31-ft seas.

The storm was not weakening yet and was moving eastward very slowly. Ocean Station Vessel "J" now had 60-kt winds and "K" to the south, 50 kt. "Kilo" was struggling to stay afloat in 41-ft seas, while "J" had problems with 30-ft seas and 23-ft swells. The LOVERVAL, at 50°N, 17°W, was mauled by 55-kt storm winds and 43-ft seas. On the 20th, the LOW moved into the Bay of Biscay, and Ocean Station Vessel "K" was still battling 55-kt winds, 39-ft seas, and 26-ft swells; and "J," 45-kt gales with 36-ft seas and 39-ft swells. The ADMIRAL W. M. CALLAGHAN, at 47.1°N, 17°W, at 0600, was being ravaged by 75-kt hurricane-force winds and 29.5-ft seas. The visibility was reduced to 1 mi, but the present weather code was missing. There are codes for blowing sand or dust, but none for water, which would probably have described the situation. At 1200, there were 14 reports of winds between 40 and 55 kt. This did not include two reports that were considered suspect, one of 75 kt and another of 65 kt. The meteorologist that plotted or analyzed the chart did not indicate why the reports were suspect, possibly because of location.

Late on the 20th, the storm took a sudden turn to the north; on the 21st, to the west; and again to the south on the 22d and 23d, into the Bay of Biscay. The LOW was rapidly weakening, but again ravaged shipping on the 22d and 23d, with gale-force winds up to 45 kt. The FERNGULF was hit by 41-kt winds near 46.5°N, 16.5°W, at 1200 on the 22d, but the 32.5-ft seas were what hurt most. On the 23d, the ATLANTIC FOREST and the SEALAND VENTURE, west of Cabo Finisterre, both had strong gales with 26- and 32.5-ft swells, respectively. Another LOW developed near Lisboa late on the 23d and became the main circulation on the 24th.

An east-west-oriented front had stagnated just south of the U. S. Gulf coast for several days. Minor waves had moved eastward along the front. On the 16th, the push from a cold High in Canada was enough to move the western part of the front southward, and a more stable wave formed off Florida.

In 12 hr it had moved eastward, off Georgia and over the Gulf Stream, with an elongated circulation stretching all along the East Coast. The CAPE BRETON MINER off Cape Cod was blown by 45-kt gales. Ocean Station Vessel "H" was riding 40-kt winds. By 1200 on the 17th, the 988-mb LOW was off Norfolk, and "H" measured 60-kt storm winds driving giant 33-ft seas. At 0000 on the 18th, "H" was still being churned by 50-kt winds and 26-ft seas. The TEXACO RHODE ISLAND, about 100 mi to the south, had the same wind and even higher seas--41 ft. At 0300 on the 18th, "H" was again measuring 60-kt winds, 28-ft seas, and 12-ft swells.

The storm continued on a northerly track, moving over land near Rhode Island late on the 17th, but it did not weaken, although 35- to 40-kt winds were the highest reported from ships off the coast.

This was one of the worst December storms to strike the U. S. east coast in years. Up to 11 in of gale-driven snow snarled some areas, sleet and freezing rain sheathed other areas. The ice storm caused the worst misery because of power outages due to fallen lines. At least seven deaths were storm-related. Three people were electrocuted by fallen powerlines. Thousands of homes in New England were without light, heat, and water. Utility companies called the storm the worst in 20 yr.

By the 20th, the 974-mb center had traveled to Cape Chidley. The CAPE BRETON MINER had followed the storm north and experienced 50-kt winds in the Gulf of St. Lawrence. Two ships off the Labrador coast were frozen by 40-kt winds, with temperatures in the teens and low twenties.

At 1200 on the 20th, the CAPE BRETON MINER was still battling 55-kt freezing winds, and Ocean Station Vessel "B" measured 35-kt gales and 15-ft seas. The LOW moved eastward again to the rugged Greenland coast, where it deposited heavy snow, but the high pressure over the Greenland icecap and the rugged coast dissipated the circulation.

This LOW can be traced from Saskatchewan, Canada, on the 21st, where it developed in a 999-mb trough.

It took 2 1/2 days to travel along the border and over the Great Lakes to reach the coast late on the 23d. During this time, the pressure had risen to 1009 mb, but it had maintained a small circulation.

Prior to reaching the Maine coast, another LOW had moved up the U. S. east coast during the period of the 20th to the 22d, causing gale winds and reports of 50- and 55-kt winds. On the 21st, the BROOKLYN, at 27.9°N, 90.8°W, south of New Orleans, found 45-kt winds in the strong northerly flow between the LOW and the following HIGH. Off the Atlantic coast near 36.9°N, 69.1°W, the MASON LYKES was battered by 50-kt winds and 24.5-ft seas. The MONT JOLY, headed for Norfolk, had 55-kt storm winds about 30 mi offshore. At 0300 on the 21st, Ocean Station Vessel "H" measured 60-kt winds and 21-ft seas.

On Christmas day, the LOW was centered off St. John's, Newfoundland, and the pressure had dropped to 988 mb. At 0000, SEDCO I was hammered by 50-kt winds, with 15-ft seas riding 16-ft swells. Twelve hours later, the AMERICAN LEADER reported 55-kt winds near 44.5°N, 42.5°W. The AMERICAN LEGEND, which was headed home for the holidays, was being washed by heavy rain and 40-kt gales at 41°N, 56°W. The drilling rig VGBZ, which has now moved to 45.2°N, 54.7°W, was whipped by 45-kt gales and 18-ft seas.

On the 26th, the LOW moved into the Denmark Strait. At 0000, Ocean Station Vessel "C" rode out 40-kt winds, which decreased to 35 kt 12 hr later. By 1200, the LOW was a 974-mb depression. The TOPDALSFJORD, near 56.5°N, 35°W, reported a roaring hurricane-force wind of 75 kt. By 1200 on the 27th, the 964-mb LOW was in the Norwegian Sea. Another LOW had meantime moved over Newfoundland, and the combined circulation resulted in an almost straight fetch from Newfoundland to Ireland. On the 28th, the LOW moved into the Barents Sea and was incorporated into another system.

A 1004-mb weak area was analyzed near Omaha, Nebr., on the 28th. It moved northeastward across the Great Lakes on the 29th, where it picked up energy and started to deepen and increase its circulation. By the 31st, it was approaching Goose Bay, Labrador, at 982-mb pressure. The CAPE BRETON MINER again was swept by 45-kt gales. The last report that I could find on the charts identified as Ocean Station Vessel "C" was for 0000 on the 31st. On the 1200 chart, a 45-kt report identified only as a ship was probably "Charlie" headed home. On the 0000 January 1 chart, the USCGC MORGENTHAU, near 49.5°N, 44.5°W, reported a roaring 60 kt, as the LOW was near 56°N, 43°W, with a pressure of 984 mb. Ocean Station "B" was fighting 40-kt easterlies. Both had 20-ft seas. Many mariners and airmen will mourn "Charlie's" departure at the end of the year.

With the New Year, a new center took over the major circulation. The LOW had formed near the frontal occlusion and moved around the older center. This mattered little as far as the mariner was concerned. It was still a vicious 972-mb storm. The KRAS, near 49°N, 40°W, and the WILKAWA, near 45°N, 39°W, were headed into 50-kt westerlies, with 20- to 25-ft seas. Far to the south on the 2d, the DART AMERICA was being hit by 50-kt winds, 20-ft seas, and 28-ft swells. There were no other reports between it and the center, 700 mi to the north. As the LOW moved eastward and then northward toward Iceland, another more powerful LOW took over, dominating the circulation from coast to coast.

Gale warnings were posted on the Great Lakes at least three times this month. On the 5th and 6th, a 992-mb LOW out of Oklahoma tracked across Lakes Michigan and Huron. On the 6th, gale warnings for winds up to 45 kt were posted.

On the 13th and 14th, the 989-mb LOW tracked eastward over Ohio, south of the Lakes. Heavy snow occurred in most areas, and gale warnings were up again. Gusts topped 45 kt on Manitoulin Island, on the Canadian side of Lake Huron.

Casualties--Early in the month, the 11,317-ton NORWEGIAN NORTRANS GLORIA went aground in heavy weather off the entrance of the Bosphorus. The Panamanian SOVEREIGN SAPPHIRE sustained weather damage on a Naples to Savannah voyage. The Cypriot motorvessel AEGIS DUTY sank 145 mi southeast of New York on the 4th. All the crew members were rescued in 5-ft seas. The 20,416-ton Italian cruise ship FEDERICO C. ran aground off Port Everglades, Fla., in fog on the 8th. No damage or injuries were reported, except for possible headaches from the free parties while she was aground. The 4,804-ton ANNA F. broke tow during stormy weather in the Baltic Sea and stranded near 55°N, 20.3°E.

The Cypriot motorvessel IRENES FAITH ran aground in high wind at Windsor, Ontario, on the 6th, with no damage. The DIM BOVITA, a 5,369-ton Romanian motorship, sank in the English Channel off Brest when she ran into heavy seas. High winds drove the 6,395-ton Greek motorship ELIZABETH onto a sandbank off Haifa on the 18th, after she had discharged a cargo of grain. Late in the month, the Liberian motorship MEXICAN TRADER (5,998 tons) had storm damage to her steering gear and ventilation hatches in a storm near 49.5°N, 17.1°W.

The newly built 59,200-ton Liberian-registered bulk carrier ELWOOD MEAD went aground on a reef near Guernsey in the English Channel on the 25th. Stormy weather was hindering salvage operations. The OMONIA (16,741 tons) sustained superstructure damage due to heavy weather on a passage Bajo Grandes to Donges. The 2,644-ton Cypriot SITIA went aground off Gaza during heavy weather on the 17th. The Liberian DONA OURANIA (8,716 tons) ran aground at Hook of Holland on the 14th, due to high winds and engine trouble. Tugs had to leave because of heavy weather. The 4,039-ton British SILVER OSPREY and the 4,943-ton Swedish IVAN GORTHON collided in fog off Drogden on the 24th.

Smooth Log, North Pacific Weather

November and December 1973

SMOOTH LOG, NOVEMBER 1973--The number of cyclone tracks was below normal and widely diffuse this month, except off the Asian coast. Another area that approached normal was a convergence of storm tracks near Queen Charlotte Islands. The normal concentration of storms along the Aleutian Islands was blocked by high pressure in that area.

The mean pressure pattern in the North Pacific also differed considerably from the climatological mean, as in the North Atlantic. This would be expected, as the weather is a continuous, rather than discontinuous, phenomenon. The meteorological situation at any one place affects and is affected by the adjacent areas. The Aleutian Low, normally 1000.4 mb and centered over the Pribilof Islands, was split into two centers. A 999-mb Low was over the Sea of Okhotsk, and a 1005-mb Low was about 250 mi west of Vancouver Island. The 1023-mb Pacific High was located near 33°N, 150°W. This was very close to the climatic position and only 2 mb higher, but the area enclosed by the lower value isobars was much larger. A 1025-mb High was centered over Yukon, Canada.

The largest anomaly was plus 17 mb, centered over Unimak Island in the Aleutians. There were three significant negative departures--a 10-mb, over the Sea of Okhotsk; a 9-mb, west of Seattle; and a 4-mb, in the south central ocean, about 27°N, 170°W.

During an average November in the western North Pacific, two or three tropical cyclones develop. One or two usually reach typhoon strength. This season, just three tropical storms developed in November. Most of the activity was confined to the South China Sea. Two affected South Vietnam,and one was destructive to the central Philippines. The eastern North Pacific tropical cyclones are described in the annual article, "Eastern North Pacific Tropical Cyclones, 1973," on page 78 of the March 1974 issue.

There were many small transient LOWs across the North Pacific during the first week of this month. Most do not show on the storm track chart, as their lifespan was less than 24 hr. Several ships reported isolated instances of 35- to 45-kt gale winds.

This storm came into being between the 1800 chart of the 5th and the 0000 chart of the 6th. At the latter time, it was southeast of Tokyo Bay, near 34.5°N, 141°E. The 1011-mb LOW really moved out. In 24 hr, it had raced to 43°N, 154.5°E, and had dropped 19 mb, to a 992-mb center. As it continued deepening, it slowed in its northeasterly track. The pressure at 1200 on the 7th was 976 mb, near 47°N, 158°E. The JAPAN MAPLE was east of the center and the front, near 47°N, 164°E, when she ran into 50-kt winds. The ANNABELLA, about 100 mi north of the center, had 40-kt gales with heavy rain. The HONSHU MARU, near 48.5°N, 164.7°E, measured 50-kt winds and 24.5-ft seas. The KATRINA also found 50-kt winds near 37.4°N, 153.5°E.

This LOW was a sprinter, rather than a long-distance runner. It slowed considerably by 0000 on the 8th, when it was located at 49.5°N, 160°E. The KANEYOSHI MARU was about 60 mi east of the center and was in a 60-kt storm. The wind was out of the southeast, but the 23-ft swells were out of the south. Further east, the UZZL, at 50°N, 168°E, was engulfed by 55-kt winds and 33-ft seas. Gales were reported ahead of and along the front as far south as 57°N. Lucky for the KANEYOSHI MARU that she was headed southwestward and the storm northeastward, for 12 hr later she was still reporting 50-kt winds.

As the LOW passed the tip of the Kamchatka Peninsula, it started to weaken and elongate, as another center developed to the north and it crowded against a 1039-mb HIGH, south of the Alaska Peninsula. With that pressure configuration, the LOW regained its wind and sprinted through the Bering Sea into the Arctic Ocean. As it passed through the Bering Strait at 1200 on the 10th, there were no ships to report, but the weather station at Mys Navarin was frozen by 80-kt northwesterly winds, with a temperature of 2°F (-16°C). Mys Shmidta, on the Chuckchi Sea, had 60-kt winds at -2°F. The LOW moved across Point Barrow and, in the Beaufort Sea, hit Barter Island with 55-kt winds. It almost made it to the North Pole. On the 15th, it was lost in the Arctic wastes near 83°N, 90°W.

As the previous LOW moved over the Beaufort Sea, a LOW formed on the cold front as it crossed Alaska into the Gulf of Alaska on the 11th. By 0000 on the 12th, the central pressure was 984 mb, near 59°N, 140°W. The SANSINENA 2 had chilling 45-kt gales, and the FERNLEAF, 56-kt storm winds, both in the vicinity of 56°N, 148°W. The FERNLEAF also reported 26-ft seas and 32.5-ft swells. At 0600, EB03 measured 45-kt winds.

The 985-mb LOW moved southeastward along the coast. Ocean Station Vessel "P" fought 40-kt gales and 25-ft seas on the 13th. By midday on the 15th, the storm had beaten itself to death on rough shores and islands along the coast.

This storm had a humble origin on the 14th, at 1014 mb, near 33°N, 157°E. It was a run-of-the-mill LOW as it moved northeastward, generally not even generating gale-force winds. It was surrounded by small high-pressure cells that inhibited its development.

On the 18th, it broke through the high-pressure block to the north, and, at 1200, the ALISHER NAVOI found 40-kt gales near 44°N, 145°W, and the WASHINGTON, 35-kt gales on the other side of the LOW, near 50°N, 161°W. The 993-mb LOW was at 48°N, 153°W, at the time. On the 19th, as the LOW moved into the Gulf of Alaska, it strengthened considerably. That day, there were eight reports of gale-force or higher winds in its vicinity. The WASHINGTON had the honor of reporting 60-kt storm winds near 49.9°N, 146°W, at 1800. She also had 21-ft seas and swells.

The SANTA MARIA wasn't far behind, with 55-kt, and the WORLD PELAGIC came in with 13-ft seas and 24.5-ft swells. On the 20th, the SANTA MARIA and the WASHINGTON were still battling 55-kt winds. To the southwest along the cold front, which was a sharp dividing line between the northerly and southerly winds of the two HIGHs, the AMERICAN LARK and the EMMA JOHANNA had 45- and 50-kt northerly winds.

On the 20th, the LOW crashed into the coast north of Vancouver Island. The ARCO SAG RIVER, off the Oregon coast, had 45-kt gales, with 33-ft seas and 25-ft swells. On the 21st, the LOW moved inland to give up its life at sea.

This LOW formed in a weak area of a trough left behind by several previous LOWs, moving through the Sea of Japan into the Sea of Okhotsk. At 0000 on the 19th, it was 998-mb at 38°N, 144°E, off Honshu. By 1200 on the 20th, it was near 44°N, 162°E, at 972 mb. Six hours earlier, it had passed south of the WRANGELL MARU, and now treated her to 65-kt northerly winds, near 43.3°N, 157°W. The GOLDEN GATE BRIDGE was south of the LOW, at 38°N, 162.5°E, and had 45-kt gales, along with 20-ft seas and swells. The BRIDGE was headed westward at 15 kt.

The LOW continued its northeasterly track into the Bering Sea, with reports of 35- to 40-kt gales common. At 1200 on the 21st, the LOW was a 962-mb storm near 55°N, 179°E. Mys Navarin was blasted again by 60-kt winds off the gulf--not exactly ideal conditions. Just to the south, a ship (the -GKX) was blown by 45-kt winds. To the south of the LOW, the DATAN MARU found 40-kt winds. Twelve hours later, other weather stations in the Bering Strait were reporting 50-kt winds. The GOLDEN ARROW, at 55°N, 180°, battled 45-kt winds. At 1200 on the 22d, the storm passed near the ILLARION RYABIKOV and treated that ship to 45-kt gales, 15-ft seas, and 26-ft swells. St. Paul Island was lashed by 40-kt winds. On the 23d, another LOW approached from the southwest and absorbed the storm on the 24th.

As the month progressed, the area of cyclogenesis moved eastward. At 0600 on the 22d, a LOW formed near 40°N, 158°E. The pressure in the area was already low, so the pressure at 1200 was 991 mb. The HOROMYA was well to the southwest of the center, near 35°N, 151°E, and on a 45-kt isotach, with 20-ft swells. At 0000 on the 23d, the developing 978-mb LOW treated the PACIFIC LOGGER to 45-kt winds, in an area well south of the center along 35°N. Two fishing boats sank in the stormy waters of the Sea of Japan, one on the 22d, and the other on the 23d. The WORLD PELAGIC was at 45°N, 179.3°W, at 0500 on the 23d, when she sent an off-time report of 55-kt winds and 32.5-ft seas.

Late on the 23d, the LOW had moved into the Bering Sea and was a 949-mb whirlpool, near 56°N, 172°W, after absorbing the previously described circulation. Winds of 40 to 45 kt were no oddity. The SPRUCE, 400 mi to the south, was bucking 50-kt winds. The storm passed along the southern Alaskan coast on the 25th, and filling commenced, but did little to slacken the offshore winds. The KATHRYN MARU, at 54.2°N, 147°W, was beset by 60-kt storm winds. Ocean Station Vessel "P," to the south, was slightly better off with 45-kt winds, but both had 20-ft seas. Late on the 25th, the LOW foundered on the mountainous Alaska coast.

A series of minor troughs were moving around the edge of the major trough and cyclonic circulation which was located in the Bering Sea. This one appeared over the southern tip of Sakhalin Island at 1200 on the 22d. A closed LOW with an obvious center appeared on the 1200 chart of the 23d, near 42°N, 152.5°E. It was also obvious to the JAPAN AMBROSE and the SHOGEN MARU as they experienced 35- and 40-kt winds south and west of the LOW, respectively. The LOW quickly developed and raced along 40°N. At 0000, it hit the JGFM with 50-kt winds, the PACIFIC LOGGER with 45-kt winds, and the NICHIHO MARU with 40-kt winds, south of the center. The PRESIDENT TAFT, at 35.4°N, 162.4°E, passed south of the center and was rolled by 60-kt winds and 24.5-ft seas off her starboard bow.

On the 25th, the LOW, now at 982 mb, turned northeastward. The HAKONE MARU had been on a collision course with the center, and the two must have met about 1200 on the 24th, but there was no report plotted for that time. At 0000, she reported 45-kt southwesterlies, 21-ft seas, and 26-ft swells. The WORLD PELAGIC seemed to be finding every storm across the Pacific this trip. Her 64-kt report, at 0000 on the 25th, near 43.7°N, 173°E, was the highest found in the data for this month. No wave heights were available.

This LOW was a long-distance runner, as it was in the Gulf of Alaska by 0000 on the 26th. Ship reports in its vicinity were scarce. On the 27th, it turned southeastward, to parallel the North American coast. The pressure in the LOW had increased, and the gradient relaxed on the 26th, but, on the 27th, it gained renewed vitality. At 1200, the INDIAN MAIL was south of Kodiak Island and blasted by 45-kt winds from the northwest. On the outer fringe of the storm, near 49°N, 158.5°W, the HOYO MARU also found the 45-kt wind band. Late on the 27th and on the 28th, the LOW paused and circled, while deciding on its next direction. The NNCR, at the mouth of the Columbia River, reported 35-kt winds off the land.

The LOW moved toward the south, then eastward, and then northeastward, while rapidly deteriorating. It finally dissipated on the mountains of British Columbia on December 2.

This LOW came out of Manchuria and crossed through the La Perouse Strait on the 27th. At the same time, another LOW was forming in the vicinity of 32°N, 163°E. Their destinations were to be the same. The Manchurian LOW moved up the Kuril Islands and was well behaved until 1200 on the 28th. It was then located at 48°N, 157°E. Near the triple point of the occlusion (43°N, 160°E), two ships reported 45-kt winds. They were the SPRUCE and the JIOW. At 1200 on the 29th, the LOW combined with the one out of the south, near 54.5°N, 164°E, into one 961-mb LOW.

At 0000 on the 27th, this LOW was near 29.5°N, 170°E. The MONTIRON, at 35.5°N, 168.5°E, was headed westward, with 60-kt northerly winds, 34-ft seas, and 30-ft swells. At 0600, she was still measuring 60-kt winds. This LOW deepened rapidly and was 984 mb at 1200. A ship reported 50-kt winds

near 32.5°N, 177.5°E, about 120 mi southeast of the LOW's center.

On the 28th, the LOW turned northward and its circulation expanded. There were gale-force wind reports all around the storm. The PACIFIC BEAR, northeast of the center and north of the warm front, near 43.5°N, 179.5°E, reported the sky obscured and 50-kt winds. The ASIA MOMO only measured 43-kt winds on her instruments, but the seas were running 19.5 ft and the swells, 32.5 ft. At 1200, the LOW was at 40.3°N, 174.5°E, and 979 mb. The PACIFIC BEAR was still bucking 45-kt winds and seas to 20 ft. At 0000 on the 29th, the major circulation of the two LOWs had combined, but two centers were still present. The KATHRYN MARU, far to the north at 53.8°N, 179.7°W, had 50-kt southeasterly winds. Northwesterly 50-kt winds were reported in the Kuril Islands. At 1200 on the 29th, the two centers had combined into a 961-mb LOW. The URBW was battered by 50-kt winds in the Sea of Okhotsk.

On the 30th, the JDND, near 47°N, 161°E, suffered 50-kt winds, with 20-ft seas and swells. Ostrov Paramushir was blown by 55-kt winds, and that lovely place, Mys Navarin, was blasted by 80-kt wind-driven snow. On December 1, the LOW started breaking down, as minor LOWs formed or entered the major circulation. Late on the 1st and on the 2d, the LOW was stationary, and, by the 3d, one of the minor LOWs became the major force.

The AMERICAN APOLLO probably felt the effects of a Tehuantepecer on the 29th, when she was struck by 50-kt northerly winds near 14.3°N, 96.2°W.

Tropical storm Sarah had a brief life in the South China Sea. She can be traced back to just east of Mindanao, where she began life as a tropical wave, along the Intertropical Convergence Zone, on about the 6th. The wave moved westward across the Island and into the South China Sea. It wasn't until the 10th, about 90 mi east of Nha Trang, South Vietnam, that Sarah became a tropical depression. She barely made it to tropical storm strength before brushing the coast of South Vietnam and weakening later on the 10th.

Some 4 days later, Thelma developed in this same area, She was detected as a tropical storm, early on the 15th, near 10°N, 110°E. A few hours later, the NISSHO MARU encountered 30-kt winds about 100 mi southeast of the storm's center. However, Thelma was too close to land to develop. She moved ashore south of Saigon on the 16th, as a tropical depression. The depression crossed the Delta and moved into the Gulf of Siam on the 17th. She finally dissipated over southern Thailand on the 18th.

Tropical storm Vera appeared on the 20th, just east of Samar in the Philippine Sea. It took her 2 days to cross the Islands. Her 40-kt winds and torrential rains caused flooding that destroyed homes and crops. At least 33 people died, including 23 who drowned in floods in Mindanao. Winds increased to 45 kt, as Vera moved over the South China Sea on the 22d. She headed northwestward toward Hai-nan. The 4,735-ton Philippine SANTA ANA was overdue, after reporting she was listing in heavy weather near 21.5°N, 119.3°E. Vera weakened to depression strength on the 25th, southwest of Hai-nan.

Casualties--Several ships had weather damage, but the exact locations and dates were not available. They were the 17,355-ton Greek tanker MESSINIAKI CHARA, Honolulu for Singapore; the 9,951-ton Greek motorvessel GRIGOROUSSA, due Yokohama; and the Cypriot motorvessel MARICHANCE, Pascagoula to Cochin. A supply vessel named BOLD VENTURE sank during heavy weather in the Persian Gulf on the 6th. The Panamanian FAIRMONT (9,474 tons) ran aground at 18.5°N, 121.4°E, on the 2d, after experiencing steering gear trouble in heavy seas. The 15,804-ton ALKAID, being towed to Taiwan to be broken up, broke from tow on the 18th, during heavy weather. The wreck was subsequently found, sunk with hull broken, near 20.7°N, 121.9°E.

SMOOTH LOG, DECEMBER 1973--The cyclone tracks were above normal this month, with more than the usual number of short-lived storms. The cyclones that traveled from the western to the eastern Pacific tracked farther south than normally. The number of storms that entered the Gulf of Alaska and those that passed onto the West Coast was much above normal. Many of these formed in the eastern half of the ocean. There were several large LOWs that dominated the northern ocean for days. Several LOWs brought heavy rain and snow to the U.S. west coast.

The pressure pattern was fairly normal according to climatology, except the centers were offset and more intense. The Aleutian Low, 1001.3 mb according to climatology, normally is an elongated oval centered along approximately 55°N between Unimak Island and the Kamchatka Peninsula. This month, there were two centers offset to the east, with the lowest pressure being 992 mb. The 1021-mb high-pressure cell that extends southwestward from the U. S. west coast was 1024 mb and south of its normal position. A trough line along 157°W, which usually isn't present, reflected the storms that originated south of the Gulf of Alaska. Higher pressure over Asia resulted in a tight gradient over eastern Siberia.

The anomaly centers were the opposite in the North Atlantic. A large minus 13-mb center was positioned in the Gulf of Alaska near 53°N, 145°W. Another negative 9-mb center was near 52°N, 180°, and a third minus 6-mb center was over the Sea of Okhotsk. A positive 6-mb anomaly was west of Baja California near 28°N, 128°W, and a positive 3-mb circular center was near 30°N, 180°. There were two large positive 15-mb anomaly centers in central Asia.

There were no tropical cyclones in the North Pacific during December.

This was one of those LOWs that appear to explode fully developed out of nowhere. Actually, this is not true, as probably a more dense network of observations taken more often would have identified and located it earlier.

The LOW developed near 49°N, 176°E, on a front that extended out of another LOW just off the Kamchatka Peninsula on the 1800 chart of the 1st. At 0000 on the 2d, it had a pressure of 978 mb. This tightened

the pressure gradient between the LOW and a HIGH to the south, and the TAKAO MARU and the TEMPLE INN both reported 40-kt winds along 45°N. By 1200, the pressure had dropped to 962 mb near Adak Island. No winds greater than 30 kt were reported, but the pressure gradient measured 100 kt on the geostrophic wind scale in areas of no reports. At 1800, the LONG CHARITY, at 52°N, 179°W, recorded 50-kt winds and 23-ft seas. The ARCTIC TOKYO measured the same values near 53.4°N, 178.6°E.

On the 3d, the HAKUKO MARU was buffeted by 45-kt gales and 28-ft swells near 51.5°N, 170.5°E. The ROKKOHSAN MARU also reported 45-kt gales, near 50°N, 174°W, but she was swamped by 46-ft seas and 46-ft swells from the west while trying to make headway toward the west-southwest at 10 kt. The report from the ATLANTIC NEPTUNE of 60-kt at 43°N, 176°W, was suspect due to transmission errors.

At 0000 on the 4th, as the LOW crossed the Aleutian Islands, two LOWs developed, the new one over 400 mi to the east. By 1200, the old LOW had deteriorated to a trough and the split had weakened the stock to such an extent that, by the 5th, it was no longer listed on the board.

A 998-mb wave formed southeast of Unimak Island on a weak front in a col area on the 1st. It was surrounded by two LOW's and three HIGH's. By 0000 on the 2d, it was gaining in strength and could be called a LOW. At 1800 on the 2d, there was no doubt. The HAVIS, at 48.7°N, 137°W, had 46-kt winds and 36-ft seas. Not far away, at 48.9°N, 136.5°W, the IDAHO STANDARD battled 70-kt winds, which decreased to 50 kt, 6 hr later. The HAVIS did not make out so well, as, at 0600 on the 3d, she still was fighting 26-ft seas and 46-ft swells. On the 4th, the LOW was absorbed by the previously described storm.

A large area of generally weak pressure was located off Japan and over the Sea of Okhotsk on the 6th. On the 7th, a 998-mb LOW developed near 42°N, 151°E. Adjustments in the wavelength pattern in the upper-air circulation was occurring at the same time, resulting in energy for increased cyclonic circulation. The NANSHO MARU, near 49°N, 170°E, east of the center, reported 40-kt winds and heavy rain. The AMERICAN LYNX, at 36°N, 148°E, southwest of the center, also had 40-kt gales and lightning. Earlier, she had reported 55-kt storm winds.

By 0000 on the 8th, the pressure had plunged to 967 mb, with the center at 50.4°N, 159°E. A 55-kt wind was reported just off the Kuril Islands. The CHUET SUSAN MARU and the GYOKUYO MARU were lashed by 40-kt gales, with seas and swells up to 15 ft. At 1200, the NANSHO MARU had traveled to 47.1°N, 163.9°E, and was being mauled by 70-kt westerly "winds" and 10-ft seas riding 32-ft swells. The DAIKEI MARU and the JAPAN MAPLE, 360 and 640 mi south of the center, respectively, were being bounced around by 45-kt gales and seas to 15-ft.

On the 9th, the storm turned easterly along 54°N, under the influence of the zonal upper-air flow. The central pressure had started to rise slowly as it moved out of the major energy source. The KINKO MARU, south of the Near Islands, was headed into 50-kt gales and 20-ft swells. On the 10th, the NANSHO MARU was still engaged with 50-kt winds, and now 25-ft swells with 21-ft seas. For the next few hours, no ships reported in the strong wind area, but, at 0000 on the 11th, the JUNEAU MARU, south of Amchitka Island, struggled with 55-kt winds.

As usual in the Pacific, the reports for 1200 were sparse. At 0000 on the 12th, the LOW was near 50°N, 153°W, and the pressure decreasing as it gained new energy. Even so, it was to lose out to another LOW which had raced out of the southwest and weighed in at 958 mb. The HAWAII, at 43.5°N, 158°W, was pounded by 50-kt winds and 48-ft seas. To the northeast, near 45°N, 156°W, another ship also had 50-kt winds, but the seas and swells were 15 and 23 ft respectively. West of the center, near 50.5°N, 165°W, the DAISHOWA MARU (a ship whose reports we continually see on the charts) found 55-kt storm winds and moderate waves.

The new LOW center passed almost directly over Ocean Station Vessel "P" at 0000 on the 12th. The editor would be interested in obtaining a barogram trace for that time. Twelve hours later, the new LOW had taken over the circulation and recorded a pressure of 954 mb at 52.5°N, 142°W. Ocean Station Vessel "P" measured 40-kt winds and 23-ft seas. Far to the southwest, near 39.5°N, 152°W, the PRESIDENT POLK raced with 50-kt winds. At the same time, a ship coded as WEBR, but which was probably the HAWAII, near 43.5°N, 158.5°W, was hammered by 40-kt gales and 36-ft seas.

High wind and coastal flood warnings were issued along the State of Washington coast on the 12th, with gusts to 65 kt. Cape Blanco, Oreg., reported winds averaging 55 kt. Later in the day, it reported 73-kt winds.

On the 13th, the LOW began filling and the winds decreased. The LOW center circled around in the Gulf of Alaska and turned northwestward to end its existence over Kodiak Island on the 16th.

Between the 13th and 16th, several relatively small but intense LOWs moved around the southeastern edge, to strike the North American coast. On the 15th, one of these caused 50- to 60-kt winds along the Washington Coast. Heavy seas caused the 8,573-ton Greek freighter ARISTAGELOS to divert from 700 mi northwest of San Francisco to Coos Bay with U.S. Coast Guard escort after her cargo of beans shifted, causing a 10-degree list.

This was another of those explosive developments. A col area of about 1014 mb lay east of Tokyo and west of a high-pressure area at 1200 on the 10th. On the 0000 chart of the 11th, a well-developed 1006-mb LOW was near 36°N, 156°E, and the JGOW reported 40-kt gales on the west side. The LOW moved northeastward, deepening 30 mb in 24 hr. The MARUSUMI MARU and another ship reported 45-kt gales north of the center. At 0600 on the 12th, the HONSHU MARU was about 100 mi southwest of the center and was pounded by measured 60-kt winds.

The storm turned northward and, at 1200 on the 12th, the JUNEAU MARU, near 50°N, 169.5°E, just south of the center, was tossed by 60-kt winds from the northwest, with 10-ft seas and 50-ft swells from the southeast. Twelve hours later, she still was battling 55-kt winds, but the seas and swells had calmed. The SHOKAI MARU, 120 mi due south of the center, had a

50-kt crosswind driving 33-ft seas. The LOW continued its northerly track, filling over the cold water of the Bering Sea, and, by the 14th, had disappeared.

This LOW formed at the apex of an occlusion, near 42.5°N, 159.5°W, at 0600 on the 15th. Minimum gale-force winds were found on the west and south sides of the LOW on the 16th, but it did not appear the LOW would develop into a significant storm, as there were a minimum of five LOWs east of 180° and north of 40°N. Small waves and LOWs were forming and dissipating in 12 to 36 hr.

At 0000 on the 17th, the 985-mb LOW was near 50°N, 147°W. Ocean Station Vessel "P" measured 65-kt hurricane-force winds. At that time, the diameter of the major circulation of the storm was only 300 to 400 mi. The LOW continued a northerly track and, by the 18th, blended into another LOW approaching from the south.

This was another of those small, intense LOWs, like the previous one. It formed on the same polar front, north of the Hawaiian Islands, as a wave on the 16th.

An upper-air LOW was over Bristol Bay, with the major trough extending almost due south. As minor waves traveled around the trough, these surface LOWs formed and raced up the leading edge of the trough.

Twelve hours after forming, at 1012 mb, the LOW had a pressure of 992 mb, near 31.5°N, 157°W. The TOYOTA MARU No. 10, about 300 mi west of the center, was swept by 50-kt winds. Nearby, the ZENKOREN MARU had 40-kt gales. Just north of the center, the ARCA had heavy rain and 40-kt gales. Late on the 17th, the HAWAIIAN PROGRESS found 50-kt winds about 600 mi south of the center.

This LOW also traveled northward, as did the prior storm. At 0000 on the 18th, it was near 41°N, 145.5°W, with a much larger circulation than the previous storm. The following ships reported 40- to 45-kt gales: GUAM BEAR, HAWAII BEAR, LETITIA LYKES, TAI NING, USCGC DILIGENCE, and YAMAMIYA MARU. This LOW also passed almost directly over Ocean Station Vessel "P," about 1500 on the 18th. Her maximum synoptic time winds were 35 kt, but for over a 6-hr period after the center passed, the waves were very confused. The 2100 report indicated northwest (310°) 5-ft seas, 21-ft swells from 120°, and 12-ft swells from 190°. The 0000 report on the 19th had 15-ft seas from 310° and 21-ft swells from 120°. The SINCLAIR TEXAS, at 55.7°N, 144.7°W, wrestled with 45-kt winds, 14.5-ft seas, and 23-ft swells.

The pressure gradient between the LOW and the West Coast was very tight, as the isobars were north-south oriented against a HIGH over the Canadian Plains. Coastal stations were not indicating high winds, and there were few coastal ship reports. Early on the 19th, the 10,059-ton Liberian freighter ORIENTAL MONARCH sank about 500 mi west of Vancouver. She reported taking on water after engine trouble. Newspaper accounts reported winds of 60 kt and waves of 30 ft in the area. All crew members were lost.

A LOW with its associated fronts, that had a pressure of 970 mb as it moved across the Baltic Sea from the Atlantic, barely managed to survive the trip across Siberia, an area of almost continuous high pressure. The high-pressure cells moved south and split as the cold front moved eastward. By the time the front approached Manchuria, it was barely identifiable. On the 19th, the Siberian High began to build again, and one of the high-pressure cells had moved across the Yellow Sea, where it began to pick up moisture. The Siberian High had built to 1066-mb by the 20th and was bringing cold, dry air from the north down over Manchuria and China. The front rapidly regenerated with the temperatures and moisture contrast over the coast. With the attendant energy, a 1017-mb LOW also developed by 1200 on the 20th. By 1200 on the 21st, it was 988 mb, over the Sea of Japan. Twelve hours later, it was 968 mb, and a station on the mainland on the Tatar Strait reported an 80-kt blizzard. Ostrov Urup in the Kuril Islands reported a 50-kt storm.

Ahead of the cold front in the warm sector, three ships reported 40-kt gales in the 22d. They were the HOWA MARU, MEISHUN MARU, and the PACIFIC BEAR. On the 23d, the SYUKO MARU found 50-kt gales near 43°N, 150°E. Small LOWs were developing and moving around the periphery of the storm. One of these almost stole the whole show and, on the 24th and 25th, was a deeper storm than the main LOW. The combined cyclonic circulation covered most of the North Pacific north of 30°N. Thirty-five- to forty-knot winds were scattered over the area. The PLUTOS, which was far to the south at 31.3°N, 152.5°E, was battered by 60-kt winds, as a minor trough waved around the southwestern edge of the large storm.

At 1200 on the 25th, the 961-mb LOW was near 44°N, 175°W. The HOWA MARU was sailing about the same direction and speed as the LOW and, near 42°N, 177°W, was hit by 55-kt winds. Late on the 25th, the LOW turned northward and treated the Alaska Peninsula to 50-kt gales on the 26th. The PHILIPPINE MAIL, 500 mi south of the center, had relatively calm 40-kt winds, but was battered by 36-ft swells. The higher winds were mostly from the south, ahead of the front. An exception was made for the CHEVRON TRANSPORTER, which entitled her to 55-kt storm winds west of the front but ahead of the LOW, near 52.7°N, 162.5°W, at 0600. An additional benefit was 29.5-ft seas. At 1200 on the 26th, the ALEX SERAFINOVICH encountered 50-kt winds just prior to passing through the frontal zone. Northwest of the LOW, which now had moved into the Bering Sea, Mys Navarin was frozen by minus 8°F winds of 80 kt that continued for over 24 hr. The central pressure had dropped to 940 mb. The center was moving northwestward and filling. It returned to the desolate waste of eastern Siberia late on the 28th and died on the 29th.

The frontal systems had moved far out on the edge of the large LOW described above. Frontal waves were forming and moving around the edge, some more intense than others. This storm formed on the 29th, in the central ocean near 32°N, 162°W, in a col area between two HIGHs. The high-pressure center off the U.S. west coast was essentially stationary, while the one over the western half of the ocean was moving eastward and northward. This increased the circulation and cyclogenesis.

On the 30th, the HIGH was being squeezed like a giant bladder between this LOW and another that was moving northeastward off the Asian coast. On the northwest side of the LOW, the AMAZON MARU,

(continued on page 200)

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

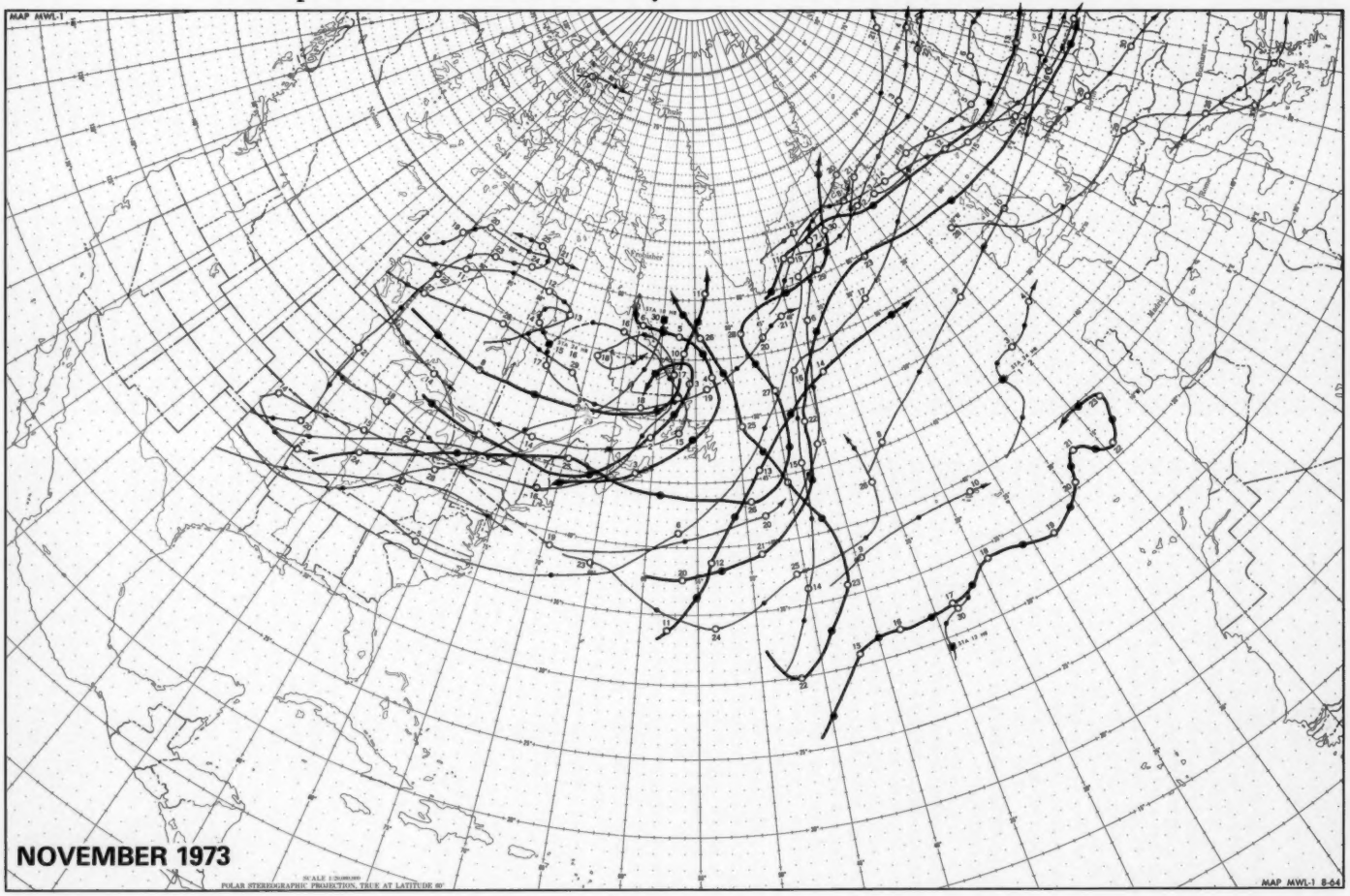

Figure 26. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

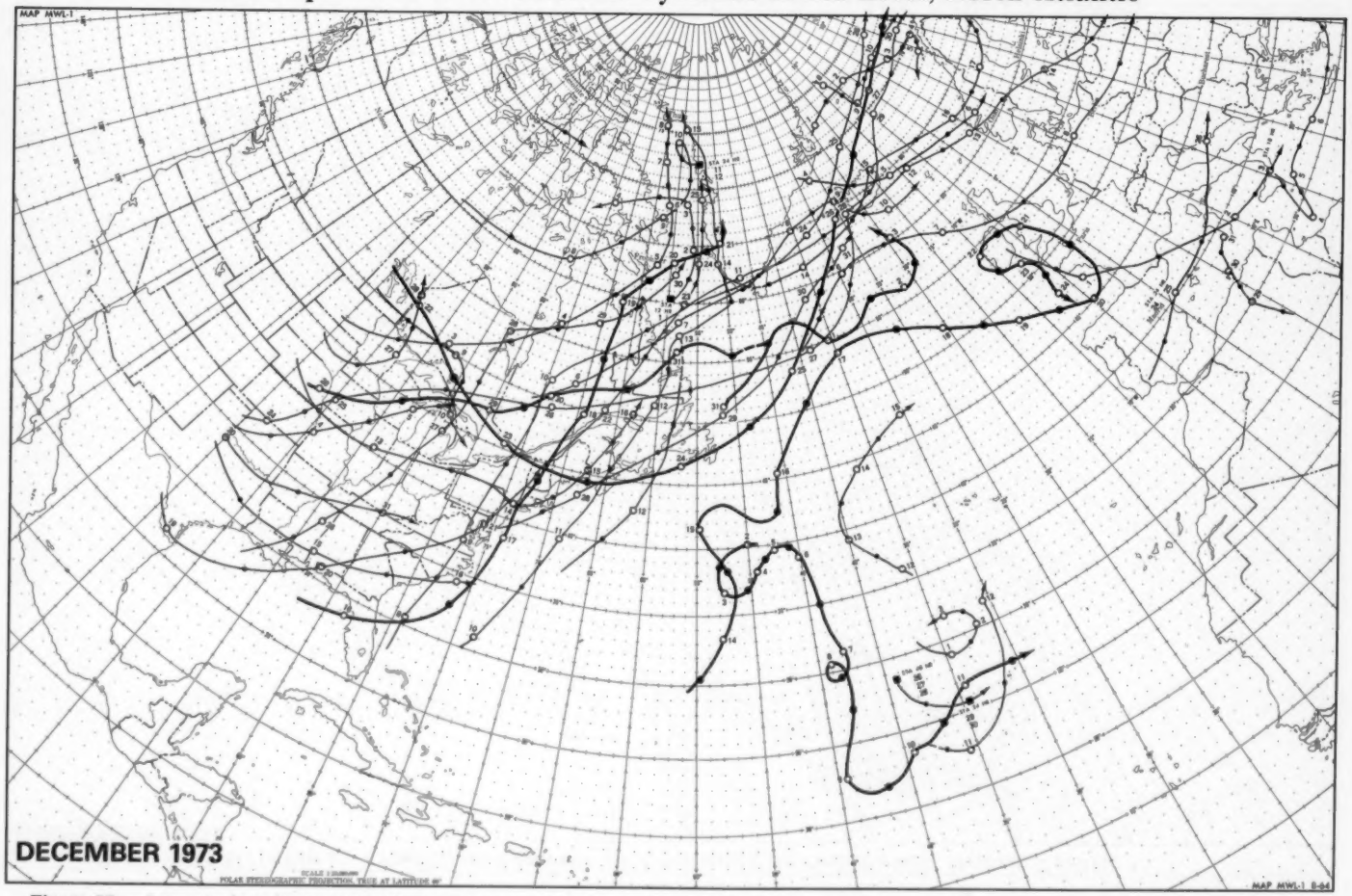

Figure 27. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

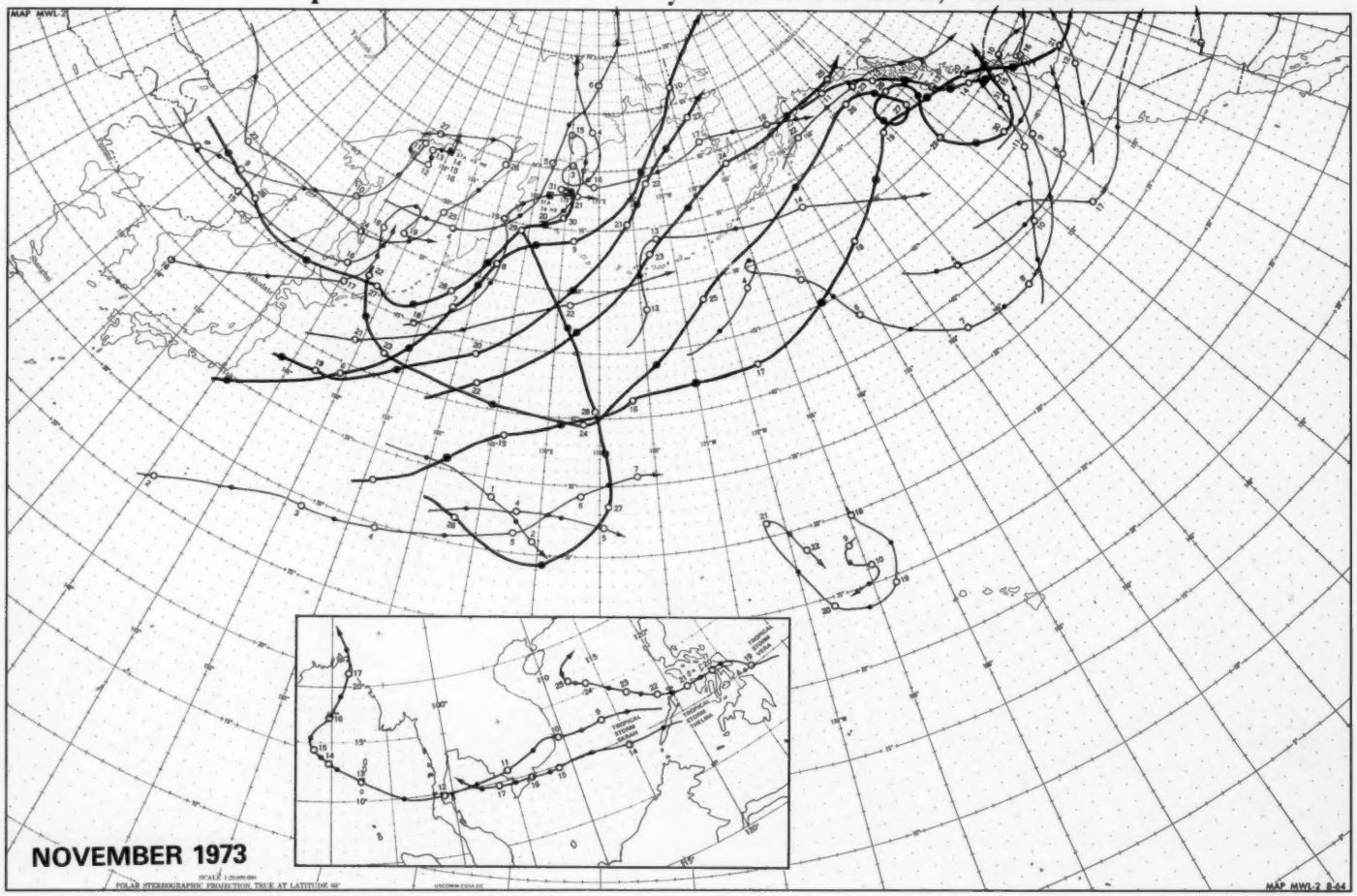

Figure 28.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

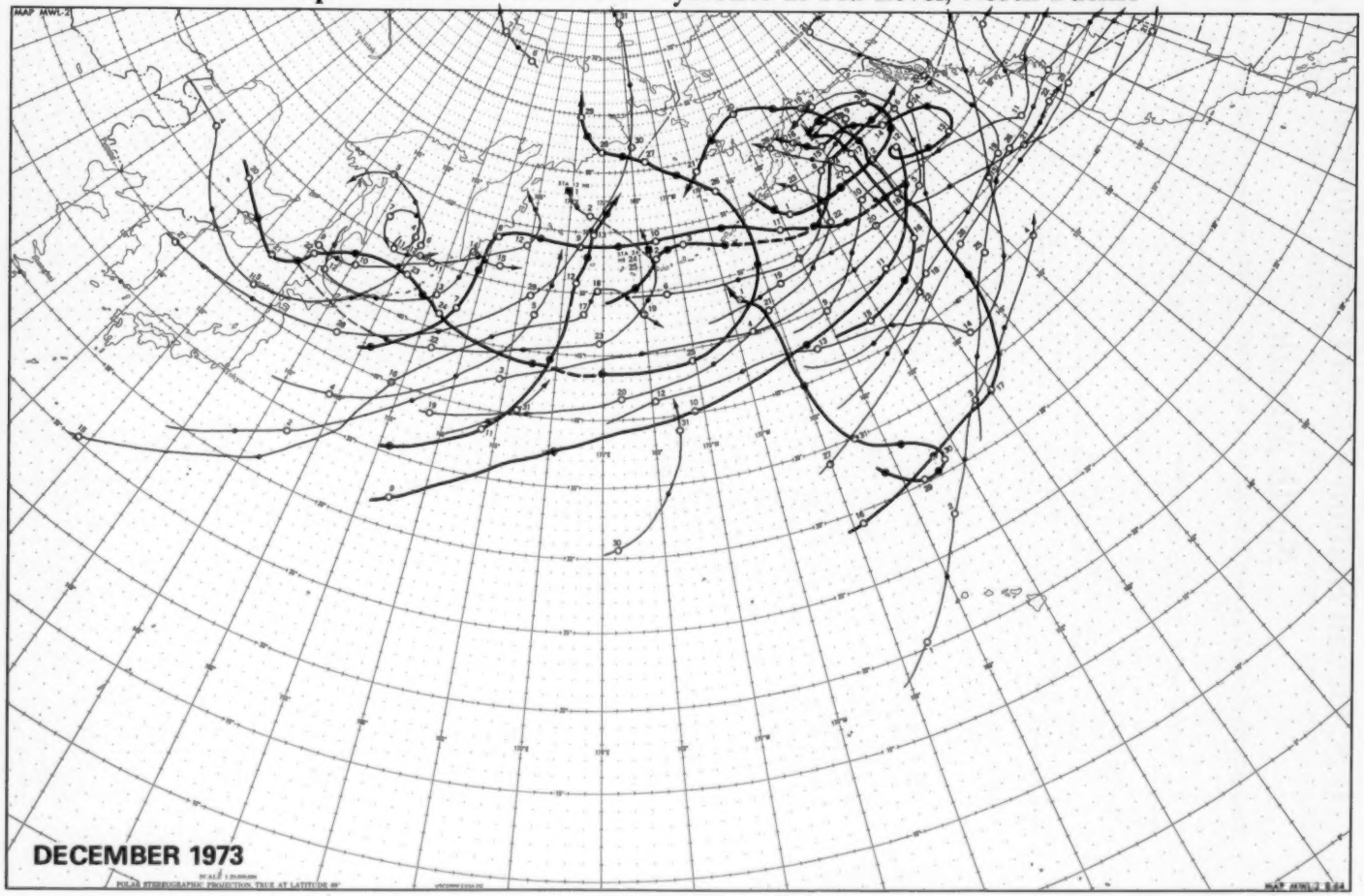

Figure 29. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 14
U.S. Ocean Station Vessel Climatological Data, North Atlantic

Ocean Weather Station 'BRAVO' 56°30'N 51°00'W **November and December, 1973**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)				
	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR
NOV	.2	23 12	4.1	7.8	03 03	- 7.5	19 12	1.0	6.8	02 21	1.2	14 19	3.2	7.2	03 18	- 4.9	11 18	- 1.1	3.2	*26 03
DEC	- 4.9	20 09	.9	6.1	11 15	- 9.4	29 00	- 2.0	4.9	13 03	1.1	12 03	3.5	5.0	*03 21	- 8.2	20 09	- 2.7	2.8	16 09

MONTH	MEANS AND EXTREMES — PRESSURE (MB)					PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) — TOTAL CLOUD				LOW CLOUD				DAYS WITH SPECIFIED WEATHER — RAIN OR				VSBY <1KM	WIND (KTS)		COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
	MIN	DA HR	MEAN	MAX	DA HR	0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN	DRZL	SNOW	TSTM	**	≥34	≥64			
NOV	975.8	05 06	999.1	1026.0	13 03	2.9	7.8	20.4	68.9	8.3	13.1	37.4	41.3	24	24	12	0	4	15	0	22	32.5	206
DEC	981.7	23 15	1007.7	1030.2	15 12	1.2	10.6	24.4	63.8	4.9	17.3	25.9	51.9	29	26	24	0	5	16	2	29	33.6	247

** VV-90-93 AND/OR W=4 COMP OB DAYS=COMPLETE OB DAYS

Wind

NOV — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.5	1.6	1.8	.0	.0	3.9	21.4
NE	.0	.1	1.0	1.5	.0	.0	3.2	21.1
E	.0	.8	3.8	5.8	12.1	1.0	23.3	32.1
SE	.0	1.5	6.6	3.3	6.3	.5	18.1	26.6
S	.7	1.9	11.2	3.5	1.2	.0	18.6	18.5
SW	.2	3.6	7.5	1.3	3.2	2.4	18.3	23.9
W	.5	3.0	3.8	.7	.0	.0	8.0	13.1
NW	.0	2.5	3.4	.7	.0	.0	6.7	14.4
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.5	14.1	39.3	18.4	22.8	3.9	100.0	23.6

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
206	230	42	11 2145	10.7	142	

DEC — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.2	2.4	.4	.0	.0	4.0	14.1
NE	.0	.7	2.1	.4	.1	.0	3.3	13.5
E	.0	3.2	1.2	.0	1.5	.0	6.0	19.0
SE	.0	1.3	2.5	2.7	.0	.0	6.6	20.0
S	.0	.0	3.4	6.0	1.4	.0	12.8	23.3
SW	.0	2.7	5.7	9.1	6.1	.4	24.0	23.7
W	.0	3.3	11.7	5.6	2.9	.0	23.6	20.1
NW	.0	2.4	5.8	8.4	1.3	.0	17.9	21.6
CALM	1.2	.0	.0	.0	.0	.0	1.2	.0
TOTAL	1.2	13.0	36.8	33.2	13.4	.4	100.0	21.5

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
247	110	50	31 1100	10.7	244	

Wave

NOV — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	2.4	1.8	.0	.0	.0	.0	.0	4.3
NE	.0	.0	.0	1.1	.1	.0	.0	.0	1.2
E	.0	1.0	6.1	9.0	10.6	3.4	.0	.0	30.1
SE	.0	3.2	3.8	1.1	4.0	2.0	.0	.0	14.0
S	.0	7.3	2.9	1.5	3.8	.0	.0	.0	15.5
SW	.1	7.3	.7	.0	2.3	3.9	.0	.1	14.5
W	.9	2.6	1.6	.0	.0	.0	.4		5.4
NW	.0	3.0	.6	.0	.5	.0	.0	.0	4.1
IND	.0	2.9	1.0	.0	1.0	.0	.0	.0	4.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.0	29.8	18.5	12.7	28.3	9.3	.0	.5	100.0

NUMBER OF OBS 205 IND=INDETERMINATE

DEC — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.4	1.2	1.6	.3	.4	.0	.0	.0	3.9
NE	.1	1.7	.3	.0	.1	.0	.0	.0	2.4
E	1.2	.7	.6	.8	2.0	.0	.0	.0	5.3
SE	.0	.9	3.1	.1	.0	.0	.0	.0	4.2
S	.4	2.9	3.8	3.3	2.1	.0	.0	.0	12.6
SW	.1	1.4	2.5	2.8	12.3	2.1	.0	.0	21.2
W	.3	1.9	6.3	1.0	11.0	1.3	.0	.0	22.0
NW	.0	1.9	9.0	3.2	3.5	1.3	.0	.0	18.8
IND	.4	5.0	1.3	1.3	1.7	.0	.0	.0	9.6
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	2.9	17.6	28.9	13.0	33.1	4.6	.0	.0	100.0

NUMBER OF OBS 239 IND=INDETERMINATE

NOV — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	1.0	24.4	6.3	2.0	4.4	.0	.0	.0	38.0
6-7	.0	2.4	10.7	3.4	10.2	1.0	.0	.0	27.8
8-9	.0	.0	.5	3.9	6.8	3.4	.0	.0	15.3
10-11	.0	.0	.0	1.9	3.9	2.9	.0	.5	10.7
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	2.9	1.0	.0	1.0	.0	.0	.0	4.9
TOTAL	1.0	29.8	18.5	12.7	28.3	9.3	.0	.5	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE
205	16.0	10	250	SWL	23 21	(DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

DEC — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	2.9	10.0	5.0	.8	.0	.0	.0	.0	18.8
6-7	.0	1.5	11.7	8.8	10.9	1.7	.0	.0	34.3
8-9	.0	.8	8.8	1.7	13.5	1.7	.8	.0	28.5
10-11	.0	.4	2.1	.4	4.6	1.3	.0	.0	9.8
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.4	.0	.0	.0	.4
IND	.0	5.0	1.3	1.3	1.7	.0	.0	.0	9.2
TOTAL	2.9	17.6	28.9	13.0	33.1	4.6	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND=INDETERMINATE
239	6.5	7	220	SEA	07 09	(DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 15
CLIMATOLOGICAL DATA

Ocean Weather Station 'CHARLIE' 52°45'N 35°30'W November and December, 1973

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
NOV	3.9	21 09	8.8	13.2	11 03	- 2.1	21 00	6.2	11.9	07 06	4.8	16 06	8.4	11.1	*28 21	- 3.9	21 09	.1	4.1	16 06
DEC	1.1	29 18	7.6	13.0	03 03	- 4.4	29 03	4.9	11.4	05 03	5.6	25 00	8.1	11.1	23 09	- 6.0	29 18	- .5	4.7	23 12

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR DRZL	SNOW	TSTM	VERY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
NOV	989.3	07 06	1012.0	1026.9	10 09	8.0	13.1	21.6	57.3	13.6	32.8	23.2	30.3	24	24	1	8	7	4	0	0	22	27.8	198
DEC	987.4	27 18	1015.1	1031.8	16 00	9.0	9.0	23.9	58.2	8.5	21.0	29.5	41.0	22	22	8	8	11	8	3	0	22	28.4	201

** VV-90-93 AND/OR N-4 COMP OB DAYS-COMPLETE OB DAYS

Wind

NOV WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	2.3	1.3	.5	.0	.0	4.0	13.7
NE	1.0	1.8	2.8	2.3	.0	.0	7.7	14.2
E	.0	.4	6.0	2.1	.0	.0	8.5	18.2
SE	.0	2.1	8.4	4.9	.0	.0	15.5	18.5
S	.0	2.8	7.8	6.9	2.3	.0	19.7	21.0
SW	.0	2.9	8.7	4.4	2.4	.0	18.3	20.2
W	.0	5.2	11.8	5.0	.9	.0	22.9	17.1
NW	.0	1.3	2.1	.0	.0	.0	3.4	12.6
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	1.0	18.6	48.7	26.1	5.5	.0	100.0	18.2

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
199	180	42	11 0100	8.0	202	

DEC WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.9	4.1	.0	.4	.0	5.3	16.7
NE	.0	.6	.7	.0	.0	.0	1.4	10.2
E	.0	1.2	2.9	.0	.0	.0	4.1	14.0
SE	.0	3.2	4.7	1.1	.6	.0	9.7	16.1
S	.0	2.4	17.2	3.7	.4	.0	23.6	18.0
SW	.0	1.1	7.6	10.9	3.6	.0	23.3	23.7
W	.0	1.7	7.1	7.8	2.5	.0	19.2	23.6
NW	.0	.7	5.0	4.7	2.5	.5	13.4	24.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	11.9	49.3	28.4	10.0	.5	100.0	20.0

NUMBER OF OBS	MAX WIND DIR	SPEED	DA HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
201	280	51	29 0200	10.8	237	

Wave

NOV WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	.0	4.5	.9	.0	.0	.0	.0	5.4
NE	.0	.5	2.8	.5	.0	.0	.0	.0	3.8
E	.0	.0	4.6	.5	.0	.0	.0	.0	5.2
SE	.0	.0	1.9	1.5	.0	.5	.0	.0	3.9
S	.0	1.0	9.0	6.9	4.5	1.8	.5	.0	23.7
SW	.0	3.5	13.1	3.5	6.2	1.8	.0	.0	28.0
W	.0	.9	13.7	3.0	.9	.0	.0	.0	18.5
NW	.0	.6	4.1	.3	.0	.0	.0	.0	5.0
IND	.0	.0	3.0	2.0	1.5	.0	.0	.0	6.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	6.5	56.8	19.1	13.1	4.0	.5	.0	100.0

NUMBER OF OBS 199 IND-INDETERMINATE

DEC WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	2.0	5.6	.0	.4	.0	.0	.0	8.0
NE	.0	.3	.9	.0	.0	.0	.0	.0	.3
E	.0	.4	.9	.0	.0	.0	.0	.0	1.3
SE	.0	3.0	5.4	1.6	.0	.0	.0	.0	10.0
S	.0	6.3	7.4	3.3	.3	.0	.0	.0	17.4
SW	.0	2.1	11.3	5.3	4.8	.0	.0	.0	23.4
W	.0	2.1	7.6	5.9	5.4	1.3	.0	.0	22.3
NW	.3	1.1	4.4	7.0	3.0	1.3	.0	.0	16.3
IND	.0	.0	1.0	.0	.0	.0	.0	.0	1.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.3	17.5	43.9	23.0	13.0	2.9	.0	.0	100.0

NUMBER OF OBS 200 IND-INDETERMINATE

NOV WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.0	2.5	12.1	5.5	.0	.0	.0	.0	20.1
6-7	.0	1.0	7.0	5.5	3.0	2.5	.0	.0	19.1
8-9	.0	3.0	32.7	4.0	6.5	1.5	.5	.0	48.2
10-11	.0	.0	2.0	2.0	2.0	.0	.0	.0	6.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.0	3.0	2.0	1.5	.0	.0	.0	6.5
TOTAL	.0	6.5	56.8	19.1	13.1	4.0	.5	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND-INDETERMINATE
199	9.0	9	190	SEA	11 06	(DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

DEC WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.5	9.5	9.0	2.0	1.5	.0	.0	.0	22.5
6-7	.0	2.0	9.5	14.0	11.0	1.5	.0	.0	38.0
8-9	.0	6.0	17.5	2.5	.5	1.0	.0	.0	27.5
10-11	.0	.0	6.0	4.5	.0	.0	.0	.0	10.5
12-13	.0	.0	.5	.0	.0	.0	.0	.0	.5
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.0	1.0	.0	.0	.0	.0	.0	1.0
TOTAL	.5	17.5	43.5	23.0	13.0	2.5	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA HR	IND-INDETERMINATE
200	6.5	8	320	SEA	18 12	(DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 16
CLIMATOLOGICAL DATA

Ocean Weather Station 'HOTEL' 38°00'N 71°00'W — November and December, 1973

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
NOV	7.8	11 00	15.2	25.2	26 03	.1	10 06	9.8	21.0	28 06	16.2	20 13	21.3	25.7	*29 15	-17.0	11 00	- 6.4	2.2	15 18
DEC	6.0	22 15	14.7	22.1	*17 00	.5	13 09	9.7	19.6	06 15	14.4	27 00	22.5	25.0	*02 00	-18.0	22 15	- 7.9	3.9	27 00

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR PCPN	DRZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
NOV	995.3	01 12	1017.1	1031.6	21 15	10.6	17.3	40.8	31.3	35.2	24.6	28.5	11.7	14	14	1	0	1	6	3	0	9	11.7	179
DEC	993.1	17 18	1017.8	1035.0	25 06	4.8	17.9	37.2	40.1	10.6	35.7	29.5	24.2	17	16	6	4	2	11	4	1	18	18.4	207

** VV-90-93 AND/OR W=4 COMP OB DAYS-COMPLETE OB DAYS

Wind

NOV — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	2.8	11.0	3.5	.0	.0	17.3	16.3
NE	.0	.8	3.9	.6	.0	.0	4.9	14.4
E	.0	1.4	1.5	.0	.0	.0	2.9	11.0
SE	.0	.6	1.8	.0	.0	.0	2.4	13.4
S	.0	.6	3.5	.4	1.4	.0	5.9	22.1
SW	.1	1.1	5.4	3.9	2.4	.0	13.0	22.0
W	.4	6.0	9.2	5.2	3.5	.0	24.3	19.7
NW	.0	4.6	10.3	13.3	1.1	.0	29.3	20.7
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.6	17.9	46.4	26.8	8.4	.0	100.0	19.2

NUMBER OF OBS 179 — MAX WIND DIR 200, SPEED 50, DA HR 29 0500 — VECTOR SPEED 11.1, MEAN DIR 290 (DIR IN DEGREES)

DEC — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.3	4.3	5.0	.0	.0	10.7	20.1
NE	.5	1.1	4.1	.5	.0	.0	6.2	12.7
E	.0	.4	2.7	.7	.5	.0	4.2	20.5
SE	.0	.5	1.7	2.7	1.9	.1	6.9	27.6
S	.0	.5	3.0	6.2	4.7	1.3	15.7	30.7
SW	.0	1.7	7.2	5.6	.7	1.9	17.1	24.2
W	.0	3.3	8.2	4.6	2.8	.0	19.1	20.5
NW	.5	1.2	7.2	9.7	.0	.0	18.6	21.2
CALM	1.4	.0	.0	.0	.0	.0	1.4	.0
TOTAL	2.4	10.1	38.6	34.8	10.6	3.4	100.0	22.7

NUMBER OF OBS 207 — MAX WIND DIR 210, SPEED 74, DA HR 21 1720 — VECTOR SPEED 7.8, MEAN DIR 246 (DIR IN DEGREES)

Wave

NOV — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	9.4	3.2	1.4	.0	.0	.0	.0	15.9
NE	.0	2.9	2.2	.0	.0	.0	.0	.0	4.7
E	.0	3.4	.0	.0	.0	.0	.0	.0	3.4
SE	.0	.6	.0	.0	.0	.0	.0	.0	.6
S	.0	3.9	1.1	.8	1.4	.0	.0	.0	7.3
SW	.6	4.7	4.1	1.4	1.8	.6	.0	.0	13.1
W	.0	9.2	6.3	2.5	3.5	.0	.0	.0	17.5
NW	.0	4.5	10.2	10.1	.0	.0	.0	.0	24.7
IND	.0	12.8	.0	.0	.0	.0	.0	.0	12.8
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.6	48.9	29.1	16.2	6.7	.6	.0	.0	100.0

NUMBER OF OBS 179 — IND=INDETERMINATE

DEC — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	3.0	2.8	5.0	.0	.0	.0	.0	10.7
NE	.0	0.6	1.2	.4	.0	.0	.0	.0	6.2
E	.0	1.3	.8	.8	1.0	.0	.0	.0	4.0
SE	.0	1.6	1.1	1.1	2.1	.6	.1	.1	6.6
S	.0	1.2	4.2	2.9	6.2	2.3	.4	.4	17.5
SW	.0	5.1	4.1	3.5	2.4	.5	1.9	.0	17.5
W	.0	4.5	4.3	2.5	2.2	.5	.0	.0	14.1
NW	.0	2.8	3.5	4.6	3.6	.0	.0	.0	14.5
IND	.0	4.3	2.4	.0	.0	.0	.0	.0	6.8
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	30.4	24.8	20.8	17.4	3.9	2.4	.5	100.0

NUMBER OF OBS 207 — IND=INDETERMINATE

NOV — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.6	29.1	7.3	.0	.0	.0	.0	.0	36.9
6-7	.0	2.8	20.7	18.2	3.9	.0	.0	.0	43.6
8-9	.0	.0	.6	.0	2.8	.6	.0	.0	3.9
10-11	.0	2.2	.6	.0	.0	.0	.0	.0	2.8
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	12.8	.0	.0	.0	.0	.0	.0	12.8
TOTAL	.6	48.9	29.1	18.2	6.7	.6	.0	.0	100.0

NUMBER OF OBS 179 — MAX WAVE HEIGHT HGT 8.0, PER 9, DIR 210, TYPE SEA, DA HR 29 06 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

DEC — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.0	17.4	7.2	1.0	.0	.0	.0	.0	25.6
6-7	.0	8.7	14.0	17.9	7.2	.5	.0	.0	48.3
8-9	.0	.0	1.0	1.9	9.2	1.9	2.4	.5	16.9
10-11	.0	.0	.0	.0	1.0	1.4	.0	.0	2.4
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	4.3	2.4	.0	.0	.0	.0	.0	6.8
TOTAL	.0	30.4	24.6	20.8	17.4	3.9	2.4	.5	100.0

NUMBER OF OBS 207 — MAX WAVE HEIGHT HGT 10.0, PER 9, DIR 180, TYPE SEA, DA HR 17 12 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 17
Selected Gale Observations, North Atlantic
November and December 1973

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt	Visibility	Present Weather code	Pressure mb	Temperature °C Air	Temperature °C Sea	Sea Waves? Period sec	Sea Waves? Height ft	Swell Waves Dir. 10°	Swell Waves Period sec	Swell Waves Height ft
NORTH ATLANTIC		NOV.															
SS AMER LEGACY	AMERICAN	2	41.2 N	59.3 W	18	27	53	5 NM	19	1004.7	18.3	15.6	12	24.5	27	>13	41
SS AMER LEGEND	AMERICAN	2	40.6 N	69.5 W	00	27	50	10 NM	13	998.1	13.9	12.2	10	19.5			
SS MORMACRIGEL	AMERICAN	2	37.3 N	70.0 W	00	27	45	5 NM	01	1009.1	18.3	21.7	8	16.5			
MV EDE SOTTORF	GERMAN	2	39.4 N	68.7 W	06	27	44	5 NM	02	1006.7	18.0		7	13			
SS AMER LEGACY	AMERICAN	3	41.0 N	60.0 W	00	27	43	5 NM	07	1009.0	15.6	21.0	10	21	27	>13	32.5
MV NORBROTT	NORWEGIAN	3	37.3 N	53.8 W	00	29	48	10 NM	25	1015.2	20.5	24.0	14	26			
MV INVERNESS	LIBERIAN	3	34.2 N	57.8 W	12	33	48	5 NM	09	1012.0	13.0	19.0	8	16.5			
SS AMER LEGACY	AMERICAN	4	40.7 N	65.2 W	00	29	45	5 NM	09	1005.0	14.0	22.8	8	16.5	29	12	21
SS DOCTOR LYKES	AMERICAN	7	37.8 N	48.5 W	00	20	M 45	10 NM	02	1012.0	21.7	22.2	6	10	20	9	14.5
SS LASH TURKIYE	AMERICAN	7	38.7 N	51.2 W	00	25	M 55	2 NM	25	1000.0	18.0	21.0					
MV HAGLEBY MAERSK	DANISH	11	48.0 N	41.3 W	06	21	50	5 NM	02	1018.0	13.4		9	19.5			
USCGC CAMPBELL	AMERICAN	11	51.0 N	38.2 W	00	20	M 45	5 NM	02	1014.4	12.8	9.0	7	23			
SS AMER ALLIANCE	AMERICAN	11	50.6 N	41.7 W	06	18	45	5 NM	81	1006.0	12.2	11.2	8	19.5	18	9	24.5
MV OLGA MAERSK	DANISH	12	34.0 N	57.7 W	06	25	60	1 NM	13	999.0	18.9						
MV ATLANTIC FOREST	NORWEGIAN	12	37.6 N	56.5 W	18	35	M 50	5 NM	80	1011.0	14.8	20.0		14.8	33	X	19.9
SS ARIZPA	AMERICAN	12	40.8 N	56.8 W	18	34	48	5 NM	02	1013.2	13.3	21.0	5	10			
SS SANTA CLARA	AMERICAN	17	33.9 N	74.6 W	00	20	M 42	10 NM	01	1012.5	21.0	21.6					
MV MAPLE	NORWEGIAN	21	36.4 N	60.8 W	18	36	42	> 25 NM	09	1023.0	16.5	20.0	7	6.5	36	12	14.5
SS LASH TURKIYE	AMERICAN	21	37.9 N	59.3 W	12	36	M 45	10 NM	18	1018.8	13.5	21.1	10	6.5	36	10	13
SS EXPORT PATRIOT	AMERICAN	21	41.9 N	49.7 W	18	34	41	10 NM	02	1006.4	2.7	6.2	5	8	36	12	13
SS DOCTOR LYKES	AMERICAN	23	43.1 N	41.8 W	12	16	M 45	5 NM	02	992.8	17.2	16.2	7	11.5	16	9	14.5
SS SEALAND MARKET	NORWEGIAN	23	40.3 N	45.1 W	12	36	47	5 NM	02	992.2	13.3	8.3	9	14.5			
SS DOCTOR LYKES	AMERICAN	24	41.5 N	48.1 W	06	30	M 70	2 NM	07	984.1	13.4	14.8	8	16.5			
SS AMER LEGACY	AMERICAN	24	54.4 N	12.6 W	00	25	45	5 NM	02	1011.5	12.3	11.2	10	19.5			
SS AMER ALLIANCE	AMERICAN	24	42.5 N	41.5 W	18	18	50	2 NM	80	982.0	13.9	21.2	12	29.5			
SS AMER LEGEND	AMERICAN	24	43.5 N	35.4 W	12	14	47	1 NM	18	1002.4	16.5	18.0					
SS DOCTOR LYKES	AMERICAN	25	39.5 N	53.4 W	00	31	M 50	5 NM	09	999.0	11.2	20.0	8	13			
SS AMER ALLIANCE	AMERICAN	25	43.3 N	41.5 W	00	23	45	10 NM	19	992.2	12.0	19.4					
USCGC BIBB	AMERICAN	25	48.0 N	52.1 W	06	34	M 47	2 NM	07	983.8	1.8	6.7	6	23			
SS DOCTOR LYKES	AMERICAN	26	34.6 N	62.5 W	06	27	M 42	> 25 NM	02	1014.6	18.8	21.2	7	11.5			
MV MIDAS RHEIN	LIBERIAN	30	36.4 N	60.8 W	12	32	M 50	1 NM	65	1010.6	16.3	18.0					
OCEAN STATION VESSELS																	
ATLANTIC B																	
USCGC MORGENTHAU	AMERICAN	2	56.5 N	51.0 W	12	11	M 48	5 NM	01	997.8	6.1	6.4	5	11.5			
USCGC MORGENTHAU	AMERICAN	3	56.5 N	51.0 W	12	09	M 41	5 NM	81	989.0	7.0	5.0	5	13			
USCGC MORGENTHAU	AMERICAN	4	56.5 N	51.0 W	12	08	M 50	1 NM	81	981.2	6.4	6.1	7	13			
USCGC MORGENTHAU	AMERICAN	9	56.5 N	51.0 W	00	12	M 48	2 NM	80	978.4	5.9	6.1	9	18			
USCGC HAMILTON	AMERICAN	10	56.5 N	51.0 W	12	11	M 46	5 NM	01	987.5	3.0	6.0	7	13			
USCGC HAMILTON	AMERICAN	11	56.5 N	50.9 W	12	23	M 58	5 NM	02	991.3	3.0	6.0	9	21			
USCGC HAMILTON	AMERICAN	12	56.5 N	51.0 W	00	24	M 50	5 NM	02	1001.9	3.1	6.0	10	23			
USCGC HAMILTON	AMERICAN	17	56.5 N	51.0 W	18	10	M 52	5 NM	02	998.3	4.5	5.2	6	14.5			
USCGC HAMILTON	AMERICAN	25	56.5 N	51.0 W	03	09	M 44	5 NM	21	1003.5	3.3	4.2	8	16.5			
USCGC HAMILTON	AMERICAN	26	56.0 N	51.1 W	00	10	M 42	1 NM	51	985.5	6.5	3.3	11	29			
ATLANTIC C																	
ATLANTIC H																	
USCGC TANEY	AMERICAN	1	38.0 N	71.0 W	15	27	M 49	10 NM	03	1000.1	20.1	21.1	7	16.5			
USCGC TANEY	AMERICAN	29	38.0 N	71.0 W	03	20	M 48	2 NM	25	1000.0	23.8	25.6	9	18			
GREAT LAKES VESSELS																	
SS JOHN SHERWIN	AMERICAN	1	44.4 N	82.2 W	18	28	M 48	> 25 NM	18		11.0	11.0	7	6.5			
SS WILLIAM A IRVIN	AMERICAN	1	45.8 N	84.7 W	18	27	M 42	10 NM	01		8.0	9.0	9	5			
SS PAUL H CARNAHAN	AMERICAN	1	43.7 N	82.5 W	18	27	M 42	10 NM	02		7.0	13.0	5	5			
SS LEON FALK JR	AMERICAN	6	47.4 N	85.6 W	06	30	M 42	10 NM	76		- 3.0	7.0	12	13			
SS CABON J CALLAWAY	AMERICAN	8	47.1 N	88.9 W	12	29	M 42	1 NM	75		- 4.0	7.0		16.5			
SS PAUL H CARNAHAN	AMERICAN	8	47.7 N	88.7 W	12	31	M 41	10 NM	02		- 4.0	7.0	6	8			
SS ASHLAND	AMERICAN	8	47.4 N	89.0 W	00	31	M 42	2 NM			- 4.0	6.0	8	10			
SS CABON J CALLAWAY	AMERICAN	8	47.1 N	88.9 W	12	29	M 42	1 NM	75		- 4.0	7.0		16.5			
SS EDMUND FITZGERALD	AMERICAN	22	47.3 N	88.3 W	06	22	M 42	10 NM	02		4.0	6.0	5	3			
SS WILLIAM A IRVIN	AMERICAN	28	42.3 N	87.3 W	12	36	M 42	5 NM	63		5.0	8.0	6	10			
SS PAUL H CARNAHAN	AMERICAN	29	42.0 N	80.9 W	00	29	M 41	10 NM	01		5.0	10.0	5	6.5			
NORTH ATLANTIC		DEC.															
SS ULTRAMAR	AMERICAN	2	49.2 N	26.0 W	18	31	48	10 NM	02	1005.8	12.0	10.6	9	16.5	31	>13	24.5
SS SEALAND MARKET	NORWEGIAN	2	49.5 N	31.2 W	12	31	49	10 NM	02	1005.8	10.0	12.8	9	13			
SS SEALAND MARKET	NORWEGIAN	3	42.7 N	42.8 W	12	27	48	5 NM	02	1002.4	7.8	15.0	9	29.5			
USCGC HAMILTON	AMERICAN	3	38.6 N	54.9 W	15	03	M 52	5 NM	16	1004.0	12.3	20.6	8	19.5			
SS TILLIE LYKES	AMERICAN	4	31.8 N	51.2 W	18	29	47	5 NM	01	1002.4	18.4	20.9	7	13			
SS SEALAND MARKET	NORWEGIAN	4	40.1 N	43.6 W	12	29	48	5 NM	02	1011.9	8.3	15.0	9	28			
USCGC HAMILTON	AMERICAN	4	38.6 N	55.1 W	00	36	M 43	1 NM	07	1005.2	11.8	16.7	10	23			
MV INVERNESS	LIBERIAN	4	34.5 N	57.5 W	12	35	48	5 NM	25	1011.3	13.0	19.0		16.5			
MV INVERNESS	LIBERIAN	5	31.9 N	54.4 W	12	35	46	10 NM	03	1019.0	16.0	19.0	12	14.5			
SS EXPORT COMMERCE	AMERICAN	9	36.4 N	73.9 W	18	21	43	5 NM	01	1009.1	16.7	15.0	6	16.5			
SS ADM W M CALLAGHAN	AMERICAN	10	42.3 N	36.5 W	18	04	48	10 NM	01	1024.2	11.7	18.3	5	8			
SS MOBIL FUEL	AMERICAN	10	39.2 N	72.4 W	00	20	48	10 NM	02	1008.8	12.2	10.0	8	13			
USCGC ACUSHNET	AMERICAN	11	35.2 N	74.5 W	17	26	M 44	5 NM	19	1011.1	11.0	23.9	9	16.5			
MV HERMANN SCHULTE	GERMAN	11	32.4 N	74.6 W	18	29	42	5 NM	02	1015.0	12.5	21.0	8	13			
SS MORMACTRADE	AMERICAN	12	23.2 N	40.4 W	00	01	48	2 NM	82	1010.0	21.3	24.9	8	14.5			
SS SEALAND VENTURE	AMERICAN	13	34.4 N	61.2 W	12	03	M 47	5 NM	60	1008.5	18.2	21.2	7	14.5			
SS EXXON WASHINGTON	AMERICAN	14	34.4 N	76.2 W	00	21	55	.5 NM	18	1004.0	19.5	21.2	6	11.5			
SS MORMACTRADE	AMERICAN	14	31.6 N	52.3 W	12	27	49	5 NM	18	1004.0	19.4	21.2	8	11.5			
SS SEALAND VENTURE	AMERICAN	15	38.6 N	41.8 W	12	17	M 49	5 NM	29	1016.2	21.5	18.3	5	10			
SS BROOKLYN	AMERICAN	17	32.2 N	77.3 W	18	30	59	10 NM	01	1009.0	10.6	28.4	5	13			
SS BOSTON	AMERICAN	17	31.5 N	70.4 W	12	16	41	5 NM	02	1007.8	21.1	23.8	5	11.5			
SS ERIC K HOLZER	AMERICAN	17	35.4 N	71.6 W	18	23	43	5 NM	02	998.5	17.0	21.2	10	19.5			
SS MORMACTRADE	AMERICAN	17	38.7 N	69.9 W	18	18	49	.5 NM	04	998.2	13.0	16.2	10	29.5			

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility	Present Weather code	Pressure mb	Temperature °C		Sea Waves+		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt				Air	Sea	Period sec	Height ft	Dir. 10°	Period sec	Height ft
NORTH ATLANTIC OCEAN		DEC.															
SS BOSTON	AMERICAN	18	32.9 N	72.3 W	00	25	47	10 NM	02	1009.8	17.7	22.2	5	19.5			
SS ORE TRANSPORT	LIBERIAN	18	32.9 N	71.7 W	06	29	41	10 NM	18	1015.9	18.0	21.0					
SS STAGHOUND	AMERICAN	18	48.0 N	25.4 W	18	31	30	.25 NM		989.0	9.5		14	29.5			
SS TEXACO RHODE ISLAND	AMERICAN	18	36.6 N	71.5 W	00	25	50	5 NM	02	1002.4	13.8	19.0					
SS NORMACTRADE	AMERICAN	18	38.0 N	70.2 W	06	24	43	10 NM	29	1003.8	10.6	23.4	9	24.5			
SS GUAM BEAR	AMERICAN	18	27.9 N	51.7 W	00	29	45	10 NM	01	1010.5	20.0	21.1	4	16.5			
SS STAGHOUND	AMERICAN	19	48.1 N	27.8 W	12	32	45	5 NM	02	1015.9	9.0	8.9	12	24.5	32	>13	32.5
MV OLGA MAERSK	DANISH	19	37.2 N	24.2 W	06	32	47	5 NM	16	1009.5	13.6		10	13			
SS LOS ANGELES	AMERICAN	19	36.4 N	18.1 W	12	32	48	5 NM	02	1002.0	16.7	18.8	12	13			
SS EXPORT FREEDOM	AMERICAN	19	38.3 N	18.0 W	12	30	45	5 NM	81	997.5	15.0	17.8	5	10	31	8	32.5
MV LOA	CHILEAN	19	44.4 N	13.7 W	00	31	44	2 NM	80	998.6	11.0	12.0					
SS ADM W M CALLAGHAN	AMERICAN	20	47.1 N	17.0 W	06	33	75	1 NM		995.0	10.0	13.4	14	29.5			
SS AMER LEGEND	AMERICAN	20	44.4 N	13.5 W	12	32	45	5 NM	01	994.5	12.8	12.3	7	11.5	34	>13	29.5
SS TETELA	HONDURAN	20	48.7 N	12.2 W	12	36	38	10 NM	03	986.5	10.0	12.7					
SS SEALAND MC LEAN	AMERICAN	20	46.2 N	17.9 W	06	32	50	5 NM	02	995.6	10.0	11.7	14	32.5			
SS AMER RANGER	AMERICAN	20	37.9 N	13.9 W	12	31	48	5 NM	01	998.2	13.0	16.7	10	19.5			
SS ATLANTIC COMMUNICATOR	AMERICAN	20	35.9 N	08.0 W	12	25	M 45	2 NM	82	995.6	14.5	16.1	9	14.5			
SS LASH TURKIYE	AMERICAN	21	37.9 N	39.3 W	12	36	M 45	10 NM	18	1018.8	13.5	21.7	10	13			
SS MASON LYKES NEW	AMERICAN	21	37.1 N	69.1 W	18	18	30	5 NM	02	1004.4	21.1	20.6	6	19.5			
SS BALTIMORE TRADER	AMERICAN	21	32.3 N	73.7 W	12	25	45	5 NM	02	1004.1	20.0	24.4	5	16.5	21	8	16.5
SS TRANSOREGON	AMERICAN	21	38.1 N	73.2 W	12	14	45	5 NM	03	994.2	15.4	15.6	7	6.5	14	10	19.5
SS TRANSHAWII	AMERICAN	21	35.1 N	74.7 W	12	26	45	5 NM	03	999.4	18.6	25.6	3	16.5			
SS ADM W M CALLAGHAN	AMERICAN	21	44.1 N	30.1 W	18	29	50	10 NM	03	1016.0	10.6	12.2	8	19.5			
SS BROOKLYN	AMERICAN	21	27.9 N	90.8 W	00	30	45	5 NM	63	1020.7	10.0	23.8	3	11.5			
MV FERNGULF	NORWEGIAN	22	46.5 N	18.5 W	12	30	41	10 NM	25	1000.0	9.0	12.0	9	32.5			
SS MASON LYKES NEW	AMERICAN	22	36.9 N	69.1 W	00	18	30	2 NM	21	1000.9	20.0	21.1	7	24.5			
USNS NORWALK T AK 279	AMERICAN	23	51.9 N	19.1 W	12	35	48	10 NM	02	1002.0	11.1	10.6	4	10	33	12	19.5
SS RIO BARIHA	LIBERIAN	23	34.0 N	35.1 W	06	20	45	5 NM	03	1002.9	20.1	21.1	5	11.5			
SS SEALAND VENTURE	AMERICAN	23	43.7 N	20.8 W	12	01	M 42	10 NM	01	1011.5	12.3	15.0	4	6.5	30	>13	32.5
MV ATLANTIC FOREST	NORWEGIAN	23	44.0 N	23.8 W	00	33	M 44	5 NM	02	1011.0	12.0			16.5	34		26
SS AMER LEGACY	AMERICAN	24	44.1 N	55.0 W	18	27	42	5 NM	07	1017.5	2.7	6.0	8	19.5			
MV NIPPON REEFER	DANISH	26	38.1 N	38.0 W	00	18	45	5 NM	50	1011.0	18.0						
SS SEALAND VENTURE	AMERICAN	26	35.4 N	48.3 W	00	01	M 46	10 NM	01	1018.2	15.4	20.6	10	19.5			
SS EXXON HOUSTON	AMERICAN	26	26.5 N	92.2 W	06	29	M 45	1 NM	82	1005.5	18.4	23.5	3	5			
SS EXPORT LEADER	AMERICAN	28	41.6 N	40.1 W	06	23	42	10 NM	62	1010.5	11.2	16.2	5	8	28	6	14.5
SS LIGHTNING	AMERICAN	28	44.9 N	33.3 W	06	23	45	2 NM	63	1011.9	12.3	13.0	8	23			
USCGC MORGENTHAU	AMERICAN	31	50.0 N	43.3 W	18	23	M 56	5 NM	80	999.8	3.8	9.3	7	18			
OCEAN STATION VESSELS																	
ATLANTIC B																	
USCGC BIBB	AMERICAN	7	56.5 N	51.0 W	06	19	M 43	.5 NM	61	1001.0	3.2	4.3	7	16.5	15	8	14.5
USCGC CHASE	AMERICAN	20	56.4 N	51.1 W	21	25	M 44	2 NM	70	996.1	- 2.8	2.8	10	18			
USCGC CHASE	AMERICAN	23	56.7 N	50.9 W	18	23	M 43	2 NM	85	981.9	- 1.8	2.8	7	11.5			
USCGC CHASE	AMERICAN	24	56.6 N	51.0 W	00	22	M 48	2 NM	65	983.8	- 4.0	2.8	10	16.5			
ATLANTIC C																	
USCGC MORGENTHAU	AMERICAN	18	52.7 N	35.5 W	00	30	M 48	5 NM	61	1001.2	7.8	8.3	6	14.5			
USCGC MORGENTHAU	AMERICAN	26	52.8 N	35.8 W	00	22	M 44	5 NM	61	994.0	7.0	7.0	6	10			
USCGC MORGENTHAU	AMERICAN	29	52.7 N	35.5 W	00	29	M 44	5 NM	85	1011.0	3.0	7.1	6	13			
USCGC MORGENTHAU	AMERICAN	30	52.7 N	35.5 W	03	16	M 44	2 NM	51	1001.0	8.8	7.2	6	11.5			
ATLANTIC H																	
USCGC TANEY	AMERICAN	6	38.0 N	71.0 W	12	18	M 48	5 NM	80	1014.9	20.0	24.4	8	16.5			
USCGC TANEY	AMERICAN	9	38.0 N	71.0 W	18	14	M 48	2 NM	61	1010.2	21.1	23.3	8	19.5			
USCGC TANEY	AMERICAN	17	38.0 N	71.0 W	12	16	M 60	2 NM	07	995.5	21.8	20.6	9	32.5			
USCGC TANEY	AMERICAN	18	38.0 N	71.0 W	03	24	M 60	5 NM	07	1004.5	11.0	22.2	9	28	16	8	11.5
USCGC CAMPBELL	AMERICAN	21	38.0 N	71.0 W	15	18	M 60	.25 NM	07	1001.2	22.0	24.0	10	21			
USCGC CAMPBELL	AMERICAN	22	38.0 N	71.0 W	00	26	M 48	2 NM	07	998.9	15.3	24.0	8	18	18	10	13
GREAT LAKES VESSELS																	
SS J L MAUTHE	AMERICAN	5	47.5 N	85.3 W	06	05	M 30	2 NM	26		- 2.0	6.0					
SS PHILLIP R CLARKE	AMERICAN	6	46.1 N	86.1 W	00	02	M 44	> 25 NM	02		- 8.0	6.0	4	3			
SS BENJAMIN F FAIRLESS	AMERICAN	9	46.8 N	86.7 W	00	18	M 43	5 NM	02		- 1.0	4.0					
SS ERNEST R BREECH	AMERICAN	10	45.2 N	88.8 W	06	35	M 43	5 NM	02		-10.0	4.0	8	10			
SS J L MAUTHE	AMERICAN	13	42.3 N	87.3 W	12	04	M 36	2 NM	22		0.0	7.0					
SS PAUL H CARNAHAN	AMERICAN	27	41.7 N	82.2 W	00	06	M 41	5 NM	21		4.0	1.0	5	6.5			
SS CASON J CALLAWAY	AMERICAN	30	43.8 N	82.5 W	06	26	M 42	> 25 NM	01		- 9.0	3.0	5	10			

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Table 18
U.S. Ocean Station Vessel Climatological Data, North Pacific

Ocean Weather Station 'NOVEMBER' 30°00'N 140°00'W November and December, 1973

MEANS AND EXTREMES

	DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)				
MONTH	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR
NOV	10.0	13 18	19.5	22.5	07 21	7.1	13 15	13.2	20.1	08 09	19.0	23 03	21.4	22.5	*18 03	- 5.7	12 15	- 1.9	.5	07 21
DEC	17.0	*13 15	19.3	21.1	11 00	9.5	01 15	13.0	19.4	*11 00	19.0	*15 03	20.1	21.7	16 00	- 3.2	*13 09	- .9	1.8	14 21

	MEANS AND EXTREMES					PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS)								DAYS WITH SPECIFIED WEATHER										
	PRESSURE (MB)					TOTAL CLOUD				LOW CLOUD				RAIN OR DRZL		SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
MONTH	MIN	DA HR	MEAN	MAX	DA HR	0-2	3-5	6-7	8 & OBSC	0-2	3-5	6-7	8 & OBSC	PCPN										
NOV	1010.0	10 03	1023.2	1032.2	22 18	7.9	21.3	44.2	26.7	23.3	22.9	31.3	22.5	8	8	0	0	0	0	0	0	30	2.9	240
DEC	1008.7	15 03	1022.5	1030.2	03 09	22.3	24.6	37.1	16.1	44.2	28.3	17.9	11.6	10	9	0	1	0	0	0	0	27	3.1	224

** VV-90-93 AND/OR R-4 COMP OB DAYS-COMPLETE OB DAYS

Wind

NOV WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

	WIND SPEED (KNOTS)								
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.9	6.7	4.7	.8	.0	.0	13.1	10.9
NE	.7	6.1	14.8	1.7	.0	.0	22.3	14.0
E	.4	6.3	11.8	.4	.0	.0	18.9	12.1
SE	.8	.8	3.3	.0	.0	.0	4.8	11.4
S	.0	.8	1.6	1.4	.0	.0	3.8	19.4
SW	.0	1.9	7.1	2.1	.0	.0	11.0	16.0
W	.0	2.7	4.0	3.1	.0	.0	9.8	18.7
NW	.0	3.0	4.1	4.7	.0	.0	11.8	18.7
CALM	4.6	.0	.0	.0	.0	.0	4.6	.0
TOTAL	7.5	27.9	50.4	14.2	.0	.0	100.0	14.1

NUMBER OF OBS 240 — MAX WIND DIR 310, SPEED 32, DA HR 30 2100 — VECTOR SPEED 9.0, MEAN DIR 005 (DIR IN DEGREES)

DEC WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

	WIND SPEED (KNOTS)								
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	1.3	1.9	.3	.0	.0	3.6	12.9
NE	.0	.9	1.3	.0	.0	.0	2.3	12.7
E	.0	1.9	3.7	.4	.0	.0	6.0	13.4
SE	.4	7.1	19.0	.9	.0	.0	27.5	13.6
S	.0	13.6	18.7	2.6	.0	.0	32.9	12.9
SW	.0	6.5	5.9	.8	.0	.0	12.9	11.9
W	.0	1.7	2.8	.3	.0	.0	4.8	14.6
NW	.0	2.7	4.8	1.6	.0	.0	9.0	13.5
CALM	.9	.0	.0	.0	.0	.0	.9	.0
TOTAL	1.3	35.7	58.3	6.7	.0	.0	100.0	13.2

NUMBER OF OBS 224 — MAX WIND DIR 310, SPEED 51, DA HR 01 0000 — VECTOR SPEED 6.3, MEAN DIR 174 (DIR IN DEGREES)

Wave

NOV WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

	WAVE HEIGHT (METERS)								
DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.8	2.7	3.1	1.4	.8	.2	.0	.0	9.0
NE	2.1	10.2	6.6	1.9	.4	.0	.0	.0	20.8
E	2.4	9.3	4.3	.0	.0	.0	.0	.0	16.1
SE	1.4	2.9	.0	.0	.0	.0	.0	.0	4.3
S	.9	2.0	1.3	.0	.0	.0	.0	.0	3.5
SW	.1	3.6	1.8	.0	.0	.0	.0	.0	10.5
W	.0	1.0	3.1	2.1	.7	.0	.0	.0	7.0
NW	.0	4.9	6.9	4.2	1.8	.0	.0	.0	19.7
IND	.0	5.0	2.1	.0	.0	.0	.0	.2	7.1
CALM	2.1	.0	.0	.0	.0	.0	.0	.0	2.1
TOTAL	9.2	40.7	31.3	9.2	3.8	.0	.0	.0	100.0

NUMBER OF OBS 240 — IND=INDETERMINATE

DEC WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

	WAVE HEIGHT (METERS)								
DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	.4	2.5	1.6	.3	.0	.0	.0	4.8
NE	.0	.9	.1	.0	.0	.0	.0	.0	1.0
E	.3	1.7	2.1	.0	.0	.0	.0	.0	4.1
SE	.1	13.3	6.0	.0	.0	.0	.0	.0	19.4
S	3.1	16.5	3.9	.0	.0	.0	.0	.0	23.6
SW	.0	9.2	1.9	.0	.0	.0	.0	.0	11.0
W	.0	3.5	1.8	.0	.0	.0	.0	.0	7.4
NW	.0	9.4	4.9	2.0	3.0	.0	.0	.0	21.3
IND	.0	5.4	.0	.0	.0	.0	.0	.0	5.4
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	3.6	64.3	23.2	3.5	3.4	.0	.0	.0	100.0

NUMBER OF OBS 224 — IND=INDETERMINATE

NOV WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS)								
	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	9.2	31.3	12.1	2.5	1.3	.0	.0	.0	56.3
6-7	.0	7.5	12.5	1.3	.8	.0	.0	.0	22.1
8-9	.0	.8	.4	.4	.8	.8	.0	.0	1.7
10-11	.0	2.9	3.3	3.0	.8	.0	.0	.0	12.1
12-13	.0	.0	.8	.0	.0	.0	.0	.0	.8
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	3.0	2.1	.0	.0	.0	.0	.0	7.1
TOTAL	9.2	40.7	31.3	9.2	3.8	.0	.0	.0	100.0

NUMBER OF OBS 240 — MAX WAVE HEIGHT: HGT 4.5, PER 5, DIR 270, TYPE SEA, DA HR 11 15 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

DEC WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS)								
	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	3.6	42.0	5.4	.0	.0	.0	.0	.0	50.9
6-7	.0	9.8	16.5	3.1	2.7	.0	.0	.0	32.1
8-9	.0	7.1	1.3	.4	1.8	.0	.0	.0	10.7
10-11	.0	.0	.0	.0	.9	.0	.0	.0	.9
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	5.4	.0	.0	.0	.0	.0	.0	5.4
TOTAL	3.6	64.3	23.2	3.5	3.4	.0	.0	.0	100.0

NUMBER OF OBS 224 — MAX WAVE HEIGHT: HGT 9.0, PER 7, DIR 310, TYPE SEA, DA HR 01 00 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 19
Selected Gale Observations, North Pacific
November and December 1973

Vessel	Nationality	Date	Position of Ship		Time	Wind		Visibility	Present Weather	Pressure	Temperature °C		Sea Waves*		Swell Waves		
			Lat. deg.	Long. deg.	GMT	Dir. 10°	Speed kt		code	mb	Air	Sea	Period sec	Height ft	Dir. 10°	Period sec	Height ft
NORTH PACIFIC		NOV.															
MV SANDAR	NORWEGIAN	4	33.5 N	162.0 E	00	04	42	2 NM	21	1012.5	17.5						
MV KATRINA	LIBERIAN	5	35.1 N	165.7 E	12	04	M 43	5 NM	02	1007.0	20.0	22.0	7	11.5	09	9	16.5
MV KATRINA	LIBERIAN	7	37.4 N	153.5 E	12	33	M 50	5 NM	02	1006.0	12.0	17.0	9	16.5			
MV HONSHU MARU	JAPANESE	7	48.5 N	164.7 E	18	14	M 50	1 NM	63	993.5	8.0	7.0	14	24.5			
MV MONTIGNY	LIBERIAN	7	45.0 N	136.3 E	12	25	M 45	5 NM	02	980.0	7.0	12.0	5	11.5	18	7	13
SS PHILLIPS LOUISIANA	LIBERIAN	7	37.0 N	159.4 W	18	02	50	10 NM	02	1023.0	15.6	18.3	8	16.5			
MV ATLANTIC PHOENIX	BRITISH	9	41.6 N	151.6 W	18	34	45	> 25 NM	82	1001.4	9.0	13.0	12	19.5			
SS PRES TYLER	AMERICAN	10	33.6 N	142.7 E	09	14	50	5 NM	03	1010.2	21.7	22.8					
SS SANSINENA II	AMERICAN	12	56.6 N	147.4 W	06	31	45	2 NM	26	1002.0	0.0	5.0	4	10	31	12	19.5
MV FERNLEAF	NORWEGIAN	12	56.0 N	147.9 W	00	32	56	1 NM	26	1004.0	1.0	4.0	10	26	32	>13	32.5
USNS FURMAN	AMERICAN	12	37.8 N	131.3 W	06	34	M 48	5 NM	02	1011.2	13.9	18.3	7	13			
MV PLUTOS	GERMAN	17	38.7 N	132.2 W	12	29	44	5 NM	03	1006.8	14.4	16.0	7	11.5			
SS HONGKONG MAIL	AMERICAN	18	46.9 N	169.7 E	18	19	45	.5 NM	65	1001.3	8.9	7.8	8	14.5			
MV ROSE	LIBERIAN	18	38.1 N	160.5 W	00	05	M 43	2 NM	62	1011.7	13.8	17.5					
SS AMER LARK	AMERICAN	18	38.7 N	160.0 W	18	01	45	5 NM	02	1015.4	10.8	11.1	8	16.5			
MV HAUL SKAGERAK	NORWEGIAN	19	37.4 N	149.3 W	21	04	M 44	2 NM	81	1024.0	13.9	16.0	6	6.5			
SS SANTA MARIA	AMERICAN	19	34.4 N	144.7 W	12	11	55	5 NM	02	971.9	6.2	6.2	8	14.5	11	>13	19.5
SS SANTA CLARA	AMERICAN	19	48.8 N	156.6 W	00	34	42	10 NM	16	1012.5	6.7	8.9					
MV ROSE	LIBERIAN	19	36.1 N	157.6 W	18	07	M 42	2 NM	07	1017.5	16.3	17.0					
SS AMER LARK	AMERICAN	19	37.3 N	162.0 W	06	02	45	5 NM	25	1015.8	13.3	14.4	8	16.5			
MV EMMA JOHANNA	GERMAN	19	31.6 N	167.7 W	15	01	50	5 NM	60	1011.8	17.5	19.5					
SS WASHINGTON	AMERICAN	19	49.9 N	146.0 W	18	29	60	1 NM	82	999.0	7.2	7.2	12	21	34	>13	21
MV WORLD PELAGIC	LIBERIAN	19	47.2 N	151.3 W	05	32	45	5 NM	01	1012.0	5.5	9.0		13	32	>13	24.5
SS SANTA MARIA	AMERICAN	20	50.7 N	139.0 W	12	32	55	5 NM	02	1009.1	6.7	7.7	8	14.5	23	>13	19.5
USCGC WINONA	AMERICAN	20	41.1 N	132.1 W	18	29	M 42	10 NM	15	1021.0	10.0	12.2	7	16.5			
MV HAVIS	NORWEGIAN	20	47.6 N	136.3 W	12	31	50	5 NM	80	1007.0	7.1	9.0					
SS IDAHO STANDARD	AMERICAN	20	46.5 N	124.8 W	18	23	45	10 NM	50	1001.0	10.0	12.8	2	8	27	13	14.5
SS WASHINGTON	AMERICAN	20	49.4 N	143.5 W	00	29	M 55	.5 NM	43	998.3	5.6	7.2					
SS SANTA MARIA	AMERICAN	21	48.1 N	136.0 W	00	32	48	5 NM	02	1018.0	7.8	10.0	7	11.5	27	12	19.5
SS ARCO SAG RIVER	AMERICAN	21	43.6 N	129.1 W	00	31	45	10 NM	02	1011.5	10.0	10.6	9	26			
SS PRES TAFT /NEW/	AMERICAN	22	35.6 N	171.7 E	18	22	45	5 NM	62	1001.0	21.7	17.3	7	14.5			
SS SUMMIT	AMERICAN	23	53.3 N	133.9 W	18	28	45	5 NM	62	999.5	7.3	9.5	4	6.5	28	12	23
SS SANSINENA II	AMERICAN	23	52.6 N	138.7 W	12	29	45	5 NM	50	1000.3	6.5	6.7	4	8	29	10	16.5
SS ARCO SAG RIVER	AMERICAN	23	52.8 N	141.0 W	12	29	45	10 NM	01	1001.7	6.0	8.6	5	14.5			
SS GALVESTON	AMERICAN	23	52.1 N	133.0 W	12	31	45	2 NM	62	997.6	4.4	8.3	5	10			
MV HAVIS	NORWEGIAN	23	54.6 N	144.8 W	06	29	50	5 NM	58	997.0	5.0	5.5					
SS IDAHO STANDARD	AMERICAN	23	54.0 N	139.1 W	12	27	55	5 NM	51	995.0	6.7	8.9	12	24.5			
MV WORLD PELAGIC	LIBERIAN	23	45.0 N	179.6 W	05	20	55	.5 NM	80	988.5	12.2	11.0	14	32.5			
MV WORLD PELAGIC	LIBERIAN	23	44.6 N	179.3 E	12	25	50	5 NM	02	993.0	10.0	11.0					
SS SUMMIT	AMERICAN	24	53.6 N	134.7 W	00	29	45	5 NM	15	1003.1	8.9	7.8	3	6.5			
SS PRES TAFT /NEW/	AMERICAN	24	35.4 N	162.4 E	00	30	60	2 NM	82	1005.8	12.2	20.0	12	24.5			
MV STAR BILLABONG	LIBERIAN	24	30.6 N	159.4 E	00	29	48	5 NM	81	1006.0	12.0	18.0					
MV PLUTOS	GERMAN	24	34.8 N	168.5 E	06	27	48	2 NM	81	1004.5	14.9	18.6	8	14.5			
SS ORIENTAL EXPRESS	LIBERIAN	24	37.1 N	152.9 W	12	29	44	5 NM	27	998.3	10.0		8	8	25	>13	13
SS WILLIAM H ALLEN	LIBERIAN	24	47.2 N	126.3 W	06	29	41	5 NM	25	1015.9	6.7	8.9	5	6.5	29	8	14.5
SS IDAHO STANDARD	AMERICAN	24	56.2 N	143.5 W	12	20	45	10 NM	21	986.5	5.0	7.2	5	8	27	8	13
MV WORLD PELAGIC	LIBERIAN	25	43.7 N	178.0 E	00	34	44	1 NM	61	989.7	6.5	12.0					
SS MILLYER BROWN	AMERICAN	25	45.3 N	131.6 W	00	27	45	1 NM	54	1017.2	10.8	12.2	6	11.5	27	8	16.5
SS JOSEPH LYKES	AMERICAN	26	46.9 N	146.4 E	06	04	45	10 NM	02	1013.2	21.2	25.0	6	6.5			
MV MONTIRON	LIBERIAN	27	35.1 N	167.5 E	06	35	M 60	2 NM	65	1000.5	17.1	19.0					
MV VAN TRIUMPH	LIBERIAN	28	42.0 N	178.4 W	12	12	M 42	5 NM	02	1004.0	14.0	13.0					
MV MONTIRON	LIBERIAN	28	33.2 N	161.4 E	18	32	M 43	2 NM	64	1000.2	20.0	20.5	5	29.5			
MV SKAUSUND	NORWEGIAN	28	51.6 N	154.6 W	12	36	48	5 NM	03	1017.3	2.5	3.5	XX	19.5			
SS PRES TAFT /NEW/	AMERICAN	28	34.3 N	138.3 E	00	31	45	10 NM	02	1013.5	15.0	17.2	5	13	30	7	16.5
MV ASIA MOMO	LIBERIAN	28	32.8 N	168.9 E	00	30	M 43	5 NM	02	1003.0	17.0	21.0	8	19.3	33	>13	32.5
SS MONTANA	AMERICAN	29	22.5 N	155.9 W	18	15	41	5 NM	02	1012.9	22.2	25.0	3	6.5	15	< 6	13
SS AMER APOLLO	AMERICAN	29	14.3 N	96.2 W	06	02	50	10 NM	02	1012.7	25.0	26.1					
MV HONSHU MARU	JAPANESE	29	49.8 N	174.5 W	06	15	M 41	5 NM	02	1009.0	8.0	6.0	7	6.3	15	9	16.5
SS ALASKA MAIL	AMERICAN	29	49.5 N	158.0 E	06	29	48	.5 NM	69	980.0	0.0	3.3	4	6.5	29	6	13
SS AMER LIBERTY	AMERICAN	30	45.4 N	167.0 E	12	25	45	5 NM	02	1011.2	4.5	10.0			29	12	23
NORTH PACIFIC		DEC.															
MV STOLT DRAGON	LIBERIAN	1	37.5 N	166.5 E	00	23	41	10 NM	01	1010.0	18.0	20.0					
SS SEATRAIN GEORGIA	AMERICAN	1	31.6 N	164.0 W	18	02	48	10 NM	02	1013.9	18.0	21.2	6	13			
MV SKAUSUND	NORWEGIAN	1	47.8 N	179.2 E	18	18	42	2 NM	63	993.2	9.0	6.0					
MV LONG CHARITY	NORWEGIAN	2	52.0 N	179.0 W	18	28	50	1 NM	86	975.0	2.5	3.0		23			
SS IDAHO STANDARD	AMERICAN	2	48.9 N	136.5 W	18	18	70	1 NM		996.0	9.4	8.9	13	19.5			
MV HAVIS	NORWEGIAN	2	48.7 N	137.0 W	18	20	48	5 NM	81	996.0	11.0	8.0		36			
MV HONSHU MARU	JAPANESE	2	47.7 N	166.5 E	12	28	M 41	5 NM	01	1007.5	1.0	5.0	7	11.5	28	11	19.5
SS EXPORT COURIER	AMERICAN	2	40.0 N	172.5 W	12	18	45	5 NM	02	1011.4	14.4	13.9	7	19.5			
SS ARCTIC TOKYO	LIBERIAN	2	53.4 N	178.6 E	18	31	M 50	.25 NM	66	971.0	1.0	6.0	16	23			
MV PLUTOS	GERMAN	2	35.5 N	147.7 E	18	06	48	1 NM	54	994.5	14.2	17.1	7	13			
MV SKAUSUND	NORWEGIAN	2	47.2 N	175.2 E	12	29	48	5 NM	62	997.6	4.0	5.0	8	16.5			
SS SEATRAIN GEORGIA	AMERICAN	2	31.7 N	162.6 W	00	02	45	10 NM	02	1016.3	17.8	21.2	5	13	02	6	16.5
SS PRES FILLMORE /NEW/	AMERICAN	3	34.9 N	151.5 E	00	29	47	5 NM	02	997.0	17.2	20.0	12	11.5			
SS MOBILE	AMERICAN	3	53.1 N	136.3 W	12	29	42	5 NM	50	997.2	5.8	9.5	9	13			
MV LONG CHARITY	NORWEGIAN	3	52.1 N	179.0 W	00	26	50	1 NM	94	971.0	2.5	9.0		24.5			
SS IDAHO STANDARD	AMERICAN	3	47.9 N	135.5 W	00	32	50	10 NM	01	1000.2	9.4	8.9	14	19.5			
MV HAVIS	NORWEGIAN	3	47.0 N	135.0 W	06	28	48	10 NM	81	1010.0	10.0	8.5		26	24	X	46
MV HOSBAY	NORWEGIAN	3	33.2 N	158.5 E	06	25	M 43	2 NM	62	1005.1	20.0	22.0		19.5			
MV VAN TRIUMPH	LIBERIAN	3	40.0 N	154.5 E	06	33	M 42	1 NM	59	985.0	12.0	14.0					
MV SKAUSUND	NORWEGIAN	3	46.9 N	173.5 E	00	29	48	5 NM	25	1007.1	4.0	5.0	9	19.5			
SS PHILADELPHIA	AMERICAN	6	53.5 N	136.1 W	18	25	50	10 NM	16	991.2	6.6	6.7	10	18	22	10	24.5
MV PLUTOS	GERMAN	6	43.2 N	174.2 W	18	28	44	5 NM	80	1005.8	8.8	11.0	8	10			
MV VAN ENTERPRISE	LIBERIAN	6	48.4 N	169.0 E	12	26	M 42	5 NM	68	1000.0	7.0	5.0	10	16.5			
MV PLUTOS	GERMAN	7	44.0 N	164.2 W	18	32	53	5 NM	80	1096.8	7.5	9.8	12	16.5			
SS PRES VAN BUREN	AMERICAN	7	39.5 N	168.5 W	06	27	55	5 NM	21	1014.9	13.3	16.7	14	19.5			
SS AMER LYNX	AMERICAN	7	34.9 N	142.0 E	00	27	55	10 NM	00	1007.4	12.2	14.4	13	16.5			
SS GOLDEN BEAR	AMERICAN	7	35.1 N	130.6 E	18	26	M 45	10 NM	02	1010.5	15.0	18.3	14	19.5			

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility	Present Weather code	Pressure mb	Temperature °C		Sea Waves*			Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10's	Speed kt				Air	Sea	Period sec	Height ft	Dir. 10's	Period sec	Height ft	
NORTH PACIFIC OCEAN		DEC.																
MV ATLANTIC PHOENIX	BRITISH	7	41.8 N	176.1 W	06	27	50	> 25 NM	02	1013.0	10.0	10.0	10	19.5				
SS AMER LANCER	AMERICAN	8	15.2 N	96.5 W	18	06	45	10 NM	02	1013.9	26.7	27.7	7	10				
MV PLUTOS	GERMAN	8	42.9 N	162.3 W	00	32	55	5 NM	28	1002.3	8.5	9.5	12	21				
MV VAN ENTERPRISE	LIBERIAN	8	46.7 N	160.5 E	12	23	M 50	5 NM	21	993.0	7.0	4.0		16.5				
MV VAN ENTERPRISE	LIBERIAN	9	46.4 N	159.4 E	06	25	M 48	5 NM	01	1000.0	7.0	4.0						
SS MARJORIE LYKES	AMERICAN	10	25.9 N	152.7 W	12	05	42	10 NM	42	1015.9	20.0	22.2	10	11.5				
SS HAWAII	AMERICAN	11	43.3 N	158.7 W	18	27	41	10 NM	02	997.0	8.7	10.3	8	19.5	27	>13	26	
SS PRES POLK	AMERICAN	11	40.5 N	161.0 W	18	29	45	10 NM	01	1011.0	10.0	13.4	5	10	32	10	14.5	
MV HONSHU MARU	JAPANESE	12	46.9 N	169.0 E	06	27	M 60	5 NM	65	985.5	2.0	4.5	8	11.5	10	13	21	
SS HAWAII	AMERICAN	12	43.3 N	158.5 W	00	28	48	5 NM	18	997.0	6.5	9.5		31				
USNS PVT JOSEPH P MERRELL	AMERICAN	12	42.8 N	157.5 W	00	29	43	5 NM	16	998.6	11.1	9.4	10	19.5				
SS PRES POLK	AMERICAN	12	40.1 N	155.1 W	06	29	50	10 NM	02	1009.9	7.7	12.2	6	8	31	10	16.5	
SS TAEPING	GERMAN	12	38.7 N	145.2 W	18	27	42	5 NM	02	1009.0	10.8	14.4						
SS TRANSCHAMPLAIN	AMERICAN	12	29.7 N	143.5 W	12	23	46	5 NM	03	1020.7	19.5	19.5						
SS J L HANNA	AMERICAN	13	28.7 N	140.1 E	00	28	48	> 25 NM	18	1012.1	20.1	22.9	5	11.5				
SS TAEPING	GERMAN	13	38.4 N	145.4 W	00	29	42	5 NM	81	1012.6	9.3	13.0						
MV TOYOTA MARU # 10	JAPANESE	14	31.6 N	145.8 W	18	19	M 44	2 NM	64	1003.3	20.0	20.0	5	6.5	23	< 6	13	
SS ARCTIC TOKYO	LIBERIAN	15	53.2 N	178.5 W	00	08	M 52	2 NM	91	987.0	4.2	6.0	9	8				
SS SANSINENA II	AMERICAN	15	43.9 N	131.2 W	18	19	45	5 NM	02	994.9	12.6	8.9	9	19.5				
SS JAPAN MAIL	AMERICAN	15	47.1 N	160.4 E	06	25	45	5 NM	70	988.8	1.7	3.3	11	24.5				
SS CHRISTOPHER LYKES	AMERICAN	16	33.0 N	152.2 E	06	22	55	2 NM	21	994.0	20.6	22.4	5	6.5				
MV LICA MAERSK	DANISH	16	31.0 N	149.7 E	06	20	45	.5 NM	62	995.1	23.2	22.0	12	10				
MV PLUTOS	GERMAN	16	34.9 N	148.0 W	12	30	43	5 NM	03	1010.6	13.2	15.4	6	13				
SS PORTMAR	AMERICAN	16	15.4 N	95.2 W	18	01	45	> 25 NM	02	1014.6	27.2	27.8	4	5	10	6	6.5	
MV CECILIE MAERSK	DANISH	17	28.2 N	157.8 W	09	29	42	2 NM	16	1009.0	19.0	22.0	6	14.5				
SS HAWAIIAN PROGRESS	AMERICAN	17	29.2 N	144.5 W	18	18	50	2 NM	81	1006.8	20.0	19.4	6	10				
MV SONETTE	SWEDISH	17	50.4 N	175.5 E	18	12	45	1 NM	69	976.0	4.0	6.0	10	19.5				
MV TOYOTA MARU # 10	JAPANESE	17	30.5 N	161.4 W	00	33	M 49	5 NM	21	1001.7	17.0	21.0	7	14.5				
MV PLUTOS	GERMAN	17	34.9 N	152.2 W	06	11	49	5 NM	21	1000.8	12.2	14.8	8	13				
SS PORTMAR	AMERICAN	17	15.3 N	93.9 W	00	34	34	10 NM	02	1012.5	25.6	27.8	6	8				
SS HAWAII BEAR	AMERICAN	18	35.6 N	152.3 W	00	32	45	10 NM	02	997.3	14.4	16.1	14	29.5				
MV SYUKO MARU	JAPANESE	18	51.0 N	179.0 W	18	09	M 41	1 NM	51	984.0	2.5	4.0	9	16.5	10	12	26	
MV STAR BILLABONG	LIBERIAN	18	46.2 N	138.0 W	12	15	45	1 NM	52	992.5	10.0	8.0						
MV PLUTOS	GERMAN	18	34.1 N	161.9 W	12	26	48	2 NM	25	1003.5	17.8	14.8	8	14.5				
MV SONETTE	SWEDISH	18	50.3 N	174.5 E	00	10	50	5 NM	07	969.0	5.0	6.0	10	23				
USNS SILAS BENT	AMERICAN	18	39.3 N	143.6 W	00	13	M 45	.5 NM	55	988.5	13.5	13.3	3	8	13	12	19.5	
SS SINCLAIR TEXAS	AMERICAN	19	55.7 N	144.7 W	00	13	48	1 NM	69	973.2	7.3	9.9	6	14.5	15	8	23	
SS SEALAND GALLOWAY	AMERICAN	20	34.1 N	174.0 W	18	23	48	5 NM	21	995.3	20.0	17.2	7	8.5				
SS MILLYER BROWN	AMERICAN	20	46.3 N	127.4 W	18	20	45	5 NM	02	994.0	11.7	10.0	8	11.5				
SS ORIENTAL ACE	LIBERIAN	21	37.2 N	174.0 W	06	25	41	10 NM	01	997.0	13.5	17.2	7	26				
MV FARO	NORWEGIAN	21	38.8 N	158.0 W	12	25	41	5 NM	69	992.0	15.0	14.5	8	16.5	29	>13	19.5	
MV HAKUSAN MARU	JAPANESE	21	39.0 N	170.4 W	06	24	M 57	5 NM	01	979.6	14.0	14.0						
SS CALIFORNIAN	AMERICAN	21	14.0 N	94.5 W	12	36	45	10 NM	02	1014.6	18.3	23.9	14	19.5				
SS CHEVRON TRANSPORTER	LIBERIAN	21	41.3 N	173.2 E	18	36	45	5 NM	50	1010.0	5.5	9.0						
MV PEARL VENTURE	LIBERIAN	22	41.7 N	156.8 W	00	24	M 49	2 NM	61	991.0	10.5	9.0	11	23				
MV PORT CHALMERS	BRITISH	22	40.8 N	150.6 E	12	23	M 45	5 NM	81	989.9	10.0	15.0	5	8				
SS SUMMIT	AMERICAN	22	55.2 N	160.2 W	12	09	45	5 NM	02	982.7	4.4	4.4	5	6.5				
SS CHEVRON TRANSPORTER	LIBERIAN	22	42.0 N	174.7 E	00	36	45	5 NM	50	1012.0	5.5	9.0						
SS MOBILE	AMERICAN	23	57.3 N	149.9 W	06	07	45	5 NM	62	992.6	3.3	3.6	4	8	05	6	14.5	
SS SUMMIT	AMERICAN	23	55.2 N	160.2 W	06	06	45	5 NM	02	982.7	4.4	4.4	7	6.5				
SS AVILA	AMERICAN	23	59.6 N	152.2 W	06	03	43	10 NM	01	999.3	- 4.4	3.3	3	11.5				
MV HARBOUR BRIDGE	SINGAPORE	23	32.3 N	168.0 W	00	24	M 41	1 NM	61	1006.8	13.5	20.0	5	10	27	11	14.5	
MV MONTIRON	LIBERIAN	24	33.9 N	178.2 E	00	22	M 44	5 NM	02	1000.7	20.1	19.0	14	26				
MV PLUTOS	GERMAN	24	31.3 N	152.5 E	18	00	60	2 NM	81	1005.0	17.2	18.2	9	13				
SS ARCO SAG RIVER	AMERICAN	24	49.3 N	136.8 W	06	27	45	5 NM	02	1001.3	9.5	6.2						
SS PHIL MAIL	AMERICAN	25	43.4 N	170.5 W	18	23	45	1 NM	52	962.3	10.0	8.9	XX	23				
SS ARCO SAG RIVER	AMERICAN	25	30.7 N	138.2 W	00	27	45	5 NM	02	1009.1	6.5	8.2	14	24.5				
MV MARITIME ACE	PANAMANIAN	26	53.8 N	161.0 W	12	22	M 45	5 NM	59	980.0	4.5	8.0	9	23				
SS CHEVRON TRANSPORTER	LIBERIAN	26	52.7 N	162.5 W	06	21	55	5 NM	02	952.0	5.5	3.5	8	29.5				
MV CHEVRON MISSISSIPPI	AMERICAN	26	56.7 N	147.8 W	18	14	45	5 NM	51	992.2	4.4	4.4	10	16.5				
SS SINCLAIR TEXAS	AMERICAN	27	57.6 N	147.9 W	18	10	50	1 NM	62	975.3		3.8	10	19.5				
SS AVILA	AMERICAN	27	57.1 N	148.2 W	18	09	50	5 NM	02	972.0	2.8	3.3	6	19.5	12	9	29.5	
SS EXPORT COURIER	AMERICAN	27	35.9 N	143.6 E	12	22	45	5 NM	00	1007.0	20.0	20.0	7	13				
MV HAVIS	NORWEGIAN	27	57.1 N	148.5 W	18	11	45	2 NM	28	981.0	5.0	5.5		32.5				
MV CHEVRON MISSISSIPPI	AMERICAN	27	55.0 N	145.1 W	18	11	55	10 NM	50	971.1	4.4	3.9						
SS SANSINENA II	AMERICAN	28	58.2 N	150.1 W	00	11	48	2 NM	65	973.9	3.8	7.4	13	24.5				
SS SINCLAIR TEXAS	AMERICAN	28	57.2 N	147.8 W	00	10	50	1 NM	62	973.5	5.0	3.4	10	19.5				
SS EXPORT COURIER	AMERICAN	28	37.9 N	151.7 E	12	34	45	5 NM	00	1006.1	9.5	14.4	6	19.5				
SS AVILA	AMERICAN	28	57.0 N	148.9 W	00	12	50	5 NM	01	968.0	4.4	3.3	6	24.5	12	9	29.5	
MV CHEVRON MISSISSIPPI	AMERICAN	28	55.0 N	146.0 W	00	16	45	10 NM	02	976.5	3.3	3.9	13	14.5				
MV MARITIME ACE	PANAMANIAN	30	53.3 N	174.6 E	00	18	M 50	5 NM	07	956.0	6.0	3.0	8	18				
SS P AND T FORESTER	AMERICAN	30	40.3 N	152.3 W	18	07	M 48	2 NM	65	1024.5	10.5	14.0	4	16.5				
SS PRESIDENT MADISON	AMERICAN	30	37.0 N	179.4 W	00	18	41	10 NM	02	1018.0	13.0	13.4	14	16.5				
MV MARITIME ACE	PANAMANIAN	30	53.3 N	174.6 E	00	18	M 50	5 NM	07	956.0	6.0	3.0	8	18				
SS P AND T FORESTER	AMERICAN	31	40.3 N	149.9 W	06	09	M 50	2 NM	21	1020.3	11.6	12.0	4	18				

* Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

NOTE: These observations are selected from those with winds of 41 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U. S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

(continued from page 187)

FEDERAL NAGARA, GEH YUNG, and the PIONEER MOON reported 35- and 40-kt gales.

As the high-pressure area moved northeast of the LOW, it combined with the high-pressure center off the U. S. west coast, with a 1042-mb center in the Gulf of Alaska. This blocked the movement of the LOW, and it turned northwestward on the 31st. The KOWLOON BAY reported 35-kt gales and 23-ft swells with 15-ft seas, north of the center near 35°N, 163°W, The SPRAY CAP, at 30°N, 152°W, east of the 981-mb center, struggled with 65-kt winds on her port side. The observation did not include a report on the state of the sea. On January 1, a new LOW approached from the southwest and became the predominant storm on the 2d.

Casualties--The Liberian bulk carrier REGENT LOTUS (8,476 tons) went aground in Toyama Bay after turning back because of heavy weather. The 10,421-ton SILVER CONSTELLATION deviated to Wake Island because of hull leakage as a result of heavy weather. The Greek motorvessel LOUCAS N. returned to Victoria, British Columbia, to restore lumber deck cargo which shifted in heavy weather. The captain and chief mate were lost overboard from the 35,589-ton CHEVRON MISSISSIPPI during a storm in the Gulf of Alaska. A third man was fatally injured while attempting to lash down gear. On the 23d, the 1,379-ton Panamanian ISLAND PEARL capsized and sank near 10.2°N, 107°E, when cargo broke loose in heavy seas. The depth of water was about 25 ft and all were rescued. The 4,024-ton OCEANIC GLORY was abandoned by her crew on the 29th, near 19.7°N, 119.6°E, after encountering heavy seas. The vessel developed a heavy list, and two holds flooded. The crew was rescued by the ATLAS. A later search for the ship proved negative.

The 9,214-ton Liberian bulk carrier PEARL VENTURE and the naval transport PVT JOSEPH F. MERRELL collided in fog off Cape San Martin on the 29th.

Rough Log, North Atlantic Weather

February and March 1974

ROUGH LOG, FEBRUARY 1974--The cyclone paths across the North Atlantic were more widely distributed this month than normally. The major tracks out of North America were reversed. The primary track was more easterly across the central United States, and the secondary track was up the St. Lawrence River valley. As the centers crossed the East Coast, they retained the more easterly direction; therefore, the average track was further south in the central Atlantic and closer to the United Kingdom, rather than Iceland, as it neared the European area. There was the normal number of cyclones in the Mediterranean Sea area, but none were severe.

The 30-day mean pressure pattern was near normal, at least in configuration. The Icelandic Low was about 400 mi due east of its 1004.3-mb climatic position, near 60°N, 28°W, at 993 mb. The Azores High was normally located, but about 4 mb higher than the usual 1020.6 mb, at 1025. The pressure over the central eastern United States was slightly below normal.

Compared to last month, the anomalies were small. There were several significant ones, though. There was a minus 12-mb center near 60°N, 20°W, that reflected the eastern displacement of the Icelandic Low. Another minus 9-mb subcenter was off Labrador, near 44°N, 50°W, with an anomaly trough that overlay a pressure trough over Newfoundland and off the U. S. east coast. A minus 7-mb anomaly, near Sardinia, reflected the cyclones that passed over the Mediterranean Sea. The higher pressure over the midcentral North Atlantic resulted in a large positive 5-mb anomaly in that area.

There were no tropical cyclones this month, and none were expected.

The first storm of the month was born on the 1st over the Oklahoma Panhandle. It was fairly weak and diffuse until it crossed the coast near Cape Charles early on the 3d. Late on the 4th, the storm center turned northeastward, and, by 1200 on the 5th, was 976 mb, near 42°N, 62°W (fig. 30). The winds were blowing now. Two crewmen of the 18,669-ton tanker

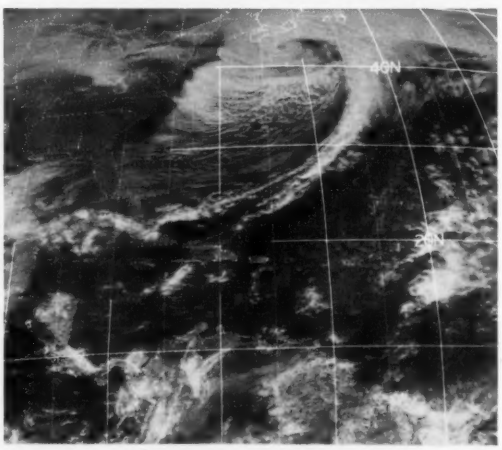

Figure 30.--The center of this extratropical LOW has an eye similar to a tropical LOW, in this ATS picture at 1555 on the 5th. The clouds south of the LOW and off the coast are alined in bands with the wind direction.

MOBIL FUEL were washed overboard and feared lost, 200 mi east of Cape Henry, in 35-ft seas and a heavy snowstorm. A Coast Guard airplane and a Navy helicopter searched for the seamen to no avail.

Winds of 45 kt were reported all around the storm by the BEI-HUDSON, HATTINGEN, MARGARET LYKES, and the MARIE L. BOLTEN. The highest seas were 16 ft, and swells, 33 ft. Just off Cape Breton Island, the LOUIS S. ST. LAURENT was beaten by 55-kt storm winds. Twelve hours later, the BOLESLAW SMIALY, 500 mi south-southeast of the center, was bounced by 50-kt winds, and the CARMEN, 320 mi south-southeast of the center, was headed into a 55-kt mauling. Gale-force winds stretched from the New Jersey coast to 40°W.

At 1200 on the 6th, the 976-mb storm was near St. Mary's Bay. The ELIZABETHPORT, MARIE L. BOLTEN, and the VC8062 were still being hounded by 50-kt winds. Seas to 33 ft were common. The LAKE LYRE slowly headed westward into 55-kt, west-northwesterly winds, driving 40-ft seas and swells. The 9,085-ton DESPINA, Hamburg for Wilmington, N. C., arrived at Wilmington on the 6th with heavy weather damage. The Canadian 3,610-ton PRINDOC, Quebec for Santa Maria, returned when about 250 mi off Halifax, due to suspected heavy weather damage. On the 7th, the SIR HUMPHREY GILBERT was off Notre Dame Bay, fighting 50-kt winds.

About this time, a new LOW formed at the occlusion and moved eastward. The original LOW dissipated at 0600 on the 8th. While this was occurring, the highest winds reported were 45 kt. At 1200 on the 8th, the new 968-mb LOW was near 57.5°N, 18.5°W. Ocean Station Vessel "I" was hammered by 50-kt winds and 26-ft seas, as the center passed about 100 mi to the south. The speed of the LOW had slowed, and, 24 hr later, "I" was still receiving 40-kt gales. On the 10th, the LOW passed over the southern part of Sweden into the continent.

Back to the storm cauldron in the Midwest, on the 6th, a 1006-mb LOW bubbled over the southwest corner of Missouri. As the LOW neared the Appalachian Mountains, the center split, and a new LOW magically appeared near Long Island at 1200 on the 7th. Twelve hours later, it was stirring up 40-kt gales off the coast.

By 1200 on the 8th, the 988-mb center was near 43°N, 52°W, and the DART AMERICA was riding 50-kt winds and 23-ft swells. Gale-force winds continued to blow in the southern quadrant. At 1200 on the 9th, the 960-mb LOW was at 48°N, 31°W, and the HATTINGEN was overtaken by 60-kt winds (fig. 31).

The 956-mb storm center passed almost directly over Ocean Station Vessel "J." At 1200 on the 10th, the MANCHESTER ZEAL was hit by 50-kt gales. Ocean Station Vessel "I" was riding out 45-kt northerly winds, with 26-ft swells out of the northwest, as the LOW passed southeast of her position.

On the 11th, the LOW turned northward and, on the 12th, eastward, as the next LOW following behind sped south and then east of this one. The westerly movement brought 35- and 45-kt winds to the north coast of Iceland. On the 13th, she faded back into the witches' brew.

This was a product of the Hatteras storm factory. A

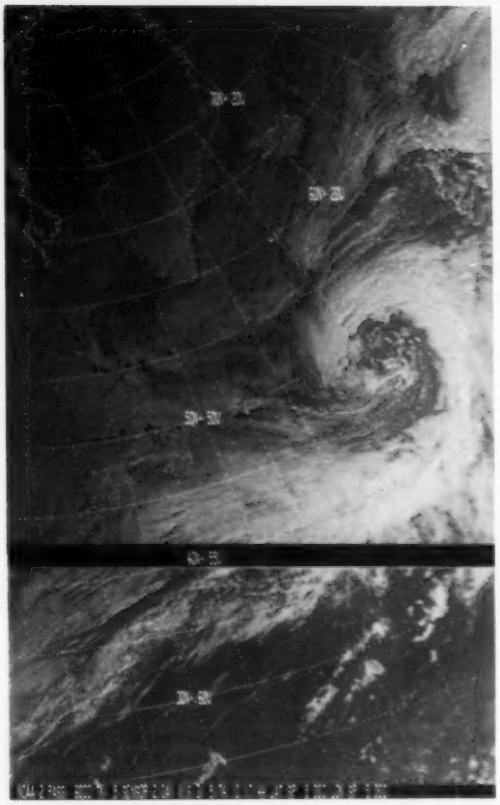

Figure 31.--A few hours later, the NOAA-2 satellite passed over the storm. The clouds are gray in the southeast and only faintly visible in the northwest because of the low sun angle.

wave formed on a front on the 8th, as it moved over the warm water of the Gulf Stream. It developed very rapidly, deepening from 1003 mb to 982 mb in 12 hr. The BEI-HUDSON was moving from one storm into another on her southeasterly track. By 1200 on the 9th, she had only managed to arrive at 37°N, 67°W, while still having 50-kt winds and 54-ft swells from 250°. The LOW was now under the zonal upper-air flow and racing eastward. The FROSTFJORD was near 39°N, 44°W, and was treated to 55-kt winds as the LOW passed about 180 mi to the north. At 1200 on the 10th, the FROSTFJORD still was battling 55-kt winds and keeping her wave heights a secret. The ERLANGEN was headed eastward at 25-kt, and the LOW passed to the north, almost as if she was standing still, and left behind memories of 60-kt winds. The KING ALFRED, 500 mi to the south, suffered 50-kt gales. The highest seas reported were now 30 ft. As the LOW approached the Irish Sea, the Brest Peninsula was pounded by 40-kt winds. The AMBOISE, off the Portuguese coast, found 50-kt gales along the front. The BELVAL also found 50-kt gales at 1200 on

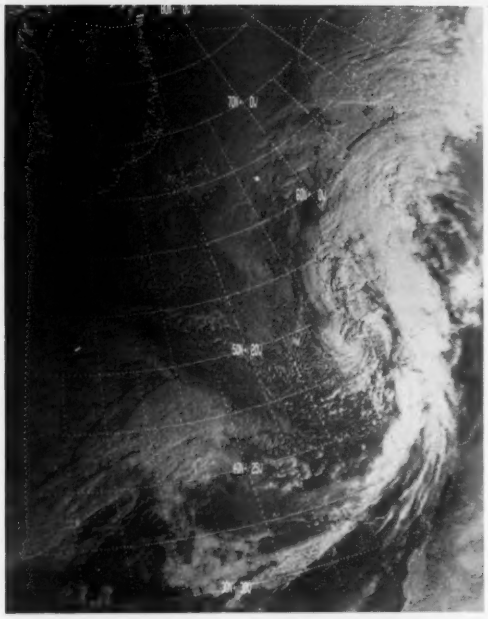

Figure 32.--This is how the storm looked from a satellite-eye view, when the LUTRIA was in trouble near the Scilly Isles.

the 11th (fig. 32). The 20,187-ton Danish containership FALSTRIA lost her rudder about 40 mi south of Cork, while on her way from Hamburg to Vancouver. The Panamanian freighter LUTRIA (fig. 33) was abandoned by its 28 crewmen near the Scilly Isles. The crew was rescued from lifeboats by Royal Navy helicopters.

The LOW continued its race across Scotland, but suddenly halted for an 18-hr rest off Vestfjorden, Norway, before moving on over Spitsbergen, to be lost over the Arctic Ocean.

As the last two LOWs moved northeastward over the eastern part of the ocean, an east-west trough line developed, stretching across Goose Bay toward Hudson Bay. A LOW developed northeast of St. John's at 0000 on the 10th and moved over Goose Bay by 1200. The MONT LOUIS, at the tip of the Gaspe Peninsula, reported 45-kt winds, and the HARENGOS, further up the St. Lawrence River, reported 40-kt blowing across the river. For the next 12 hr, the LOW was almost stationary, but the CRYOS was plotted on the chart just south of the Newfoundland coast with 70-kt winds. The air temperature was 16°F. At 1200 on the 11th, as the LOW moved eastward, the AMERICAN ACE, at 49°N, 40°W, was hit by 50-kt winds, 30-ft seas, and 33-ft swells.

It was on the 12th that one of the previous LOWs turned westward, and this was the demise of this LOW, as it was absorbed by the larger circulation.

This was another case of cyclogenesis over the Gulf Stream off Cape Hatteras, on the 11th. As usual in these cases, the LOW developed rapidly, and, by 1200 on the 12th, was 987 mb, near 38°N, 59°W. Gale-

Figure 33.--A Royal Navy helicopter hovers near the LUTRIA, off the Scilly Isles. The helicopter rescued 28 crewmen of the stricken ship after they abandoned it for lifeboats on the stormy Atlantic. Wide World Photo.

force winds were blowing in the south and west quadrants. Late on the 12th or early on the 13th, the LOW split into two centers, and the northeasterly one became the dominant storm. The KING ALFRED reported heavy rain with 45-kt winds. Later in the day, on the 13th, the 967-mb storm was really winding up. The C.P. DISCOVERER was within 60 mi of the center, reporting 40-kt winds. To the south, the PANDO GULF found the same speed. In the warm sector southeast of the center, the LEONID KRASIN had 45-kt gales. About 600 mi southwest of the center, the KING ALFRED was still involved with 50-kt storm winds. The 4,311-ton Greek motorvessel MARGETINA was disabled due to fuel contamination caused by violent weather approximately 800 mi east of Bermuda on the 13th.

The midnight observations only had one 40-kt wind report, and there were no reports within 450 mi of the center. At 1200 on the 14th (fig. 34), the 958-mb LOW was at 52°N, 25°W. The LUISE LEONHARDT, 500 mi due south, near 48°N, 24°W, was mauled by 60-kt winds and 33-ft seas. To the southwest of the center, the LEONID KRASIN was still involved with 55-kt winds and 36-ft seas. Between these two, the AMERICAN LEGEND found 50-kt gales. Many ships were reporting 35- to 45-kt gales all around the storm.

During the night, the winds reported were not as high--50 kt--but the seas and swells increased. Ocean Station Vessel "K" was tossed by 52-ft seas, the LE BASQUE by 46-ft seas, and the FORT CREVE COEUR by 33-ft swells.

Later in the day, at 1200 on the 15th, the reports picked up again. The LE BASQUE was still battling 50-kt winds. The ATLANTIC CHAMPAGNE found the 60-kt isotach, combined with the 39-ft isoline. Two newcomers to the high wind and sea fracas were the FRANKFURT and the NOVELIST, which weighed in at 55 kt. The storm passed over Ireland and England on the 16th and was losing some of its muscle. Gale winds were still plentiful off the Portuguese, French, and Irish coasts. Once on the downhill path, though, it rapidly became a has-been.

While the previous storm was delivering its last punches to shipping in the northeast Atlantic, this one was just forming. There were three large LOWs and two large HIGHs already churning the North Atlantic, and there hardly seemed room and energy for another. One of the other LOWs was located over Cape Chidley, with a front that curved to near Cape Hatteras. As usual, a 1010-mb wave formed on the front near 35°N, 70°W. It moved northeastward and, within 12 hr, was producing gale-force winds.

By 1200 on the 16th, it was near 44°N, 46°W. The CRYOS, south of Newfoundland, reported 60-kt winds, and the SHEAF CREST, southwest of the LOW center, near 39.5°N, 51°W, was battered by 50-kt winds, seas over 33 ft, and swells of 20 ft. The LENINSKIE GORY, at frontal passage, had 50-kt gales and 25-ft seas and swells.

The storm was now moving northward and, on the 17th, absorbed the remains of the LOW that was over Cape Chidley. Although the gradient was very tight, 50-kt winds were the maximum reported, and the honor went to ATLANTIC CAUSEWAY. On the 18th, the storm battered the southeast coast of Greenland, which spelled its demise on the rugged coast and ice-covered interior.

This storm goes back to the 17th and 18th, where it generated out of a generally diffuse weather pattern over the Great Plains. A dumbbell-shaped double high-pressure system had to move before the LOW could follow. By the 19th, the main portion of the HIGH had moved eastward, and the 989-mb LOW started its move toward the northeast. Early on the 20th, while the LOW was still over Ohio, gale-force winds were blowing off the East Coast. Off Cape Hatteras, a ship reported 45-kt winds just ahead of the front. Gale winds now extended north to Nova Scotia.

At 0000 on the 21st, the 984-mb LOW was near Prince Edward Island. The SIR HUMPHREY GILBERT, at 45°N, 58°W, was ravaged by 70-kt hurricane-force winds. The HAHNENTOR, further south, was washed by rainshowers driven by 45-kt gales. Neither reported sea conditions. Later on the 21st, a LOW developed south of the main center (fig. 35), and the CRYOS was hammered by 60-kt winds near 46.5°N, 57°W. The drilling rig VGBZ had 50-kt winds, as did the GOIB at 40°N, 60°W. Twenty-five foot waves were

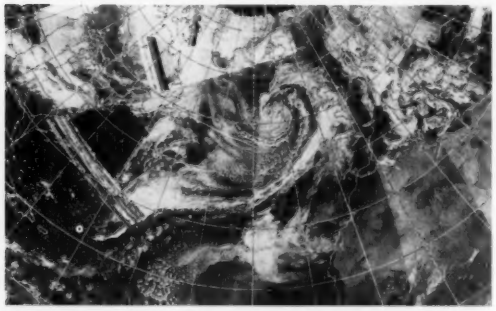

Figure 34.--There appear to be two centers, rather than one, in this computerized composite satellite picture which was sensed only 1 hr prior to map time. One is near 52°N, 23°W, and the other near 52°N, 27°W.

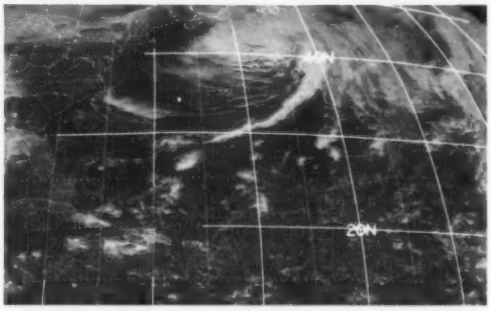

Figure 35.--The soft, fluffy appearance of the clouds, in this ATS picture at 1528 on the 21st, gives no ready indication of the violent winds beneath them. Only surface observations can accurately supply this vital information.

the highest reported. The winds were still roaring at 0000 on the 22d, when the CRYOS came in with devastating winds of 90 kt, near 46°N, 57.5°W. Further south, the HAHNENTOR, at 39.5°N, 55.5°W, almost matched that with an 80-kt report. The double center was still present, but, by 1200 on the 22d, the main center had again taken over the center ring at 984 mb. With this relaxation of the gradient, the CRYOS reported a paltry 40-kt gale. The LOW moved northward across Ocean Station Vessel "B," headed into the Labrador sea and self-destruction.

Casualties--This was not a particularly good month on the Atlantic. The 10,006-ton Greek freighter AMETHYST was forced aground by rough weather off the mouth of the Douro River, Portugal, while waiting to enter the harbor. The KEYTRADER, 11,476 tons, was refloated in the Mississippi River and towed to a safe berth (Mariners Weather Log, Vol. 18, No. 2). The 20,500-ton DOCTOR LYKES regrounded in the Southwest pass of the Mississippi River and was fogbound on the 7th. On the 17th, a LOW was located over Tunisia, and land station measurements did not indicate what was going on over the Tyrrhenian Sea off the Italian west coast. The 497-ton Italian-registered OMEGA sank in the stormy sea after hitting a rock. Seven crewmen were lost. The captain swam for 12 hr before reaching Sardinia's coast. HURRAH! The ELWOOD MEAD was freed from the reef in the English Channel after running aground on Christmas Day. She weathered some severe gales while stuck fast. The Liberian bulk carrier KONKAR RESOLUTE (25,139 tons) and the 13,737-ton tanker SOPHIA TRANSOCEANIC collided in dense fog off the Hook of Holland.

ROUGH LOG, MARCH 1974--The number of storms and their tracks were near normal this month, but they were more intense, with lower pressures in the mean. There was also a tendency to be more concentrated in the path toward the Denmark Strait, south of Greenland and Iceland. The storms in the Mediterranean Sea were near normal, but shifted more to the west, with several off the coast of Portugal and Morocco.

The 30-day mean sea-level chart was normal in appearance, but the central pressures were more extreme. The 1005.3-mb Icelandic Low at 993 mb was located about 100 mi south of Kap Farvel, slightly west of its climatological position. The Azores High was 5 mb higher than the mean, at 1025 mb, and near its normal position.

The major departures were associated with pressure centers. A negative 13-mb anomaly was centered near 60°N, 50°W, just west of the Icelandic Low, and reflected its lower pressure and western displacement. A negative 11-mb anomaly center over Baffin Bay resulted from a deeper and sharper trough in that area. A negative 4-mb anomaly was located over the western Mediterranean Sea. The major positive anomaly was 15 mb over northern Scandinavia. A ridge of the Siberian High pushed into the Norwegian Sea, where normally a trough of the Icelandic Low is located. The higher pressure of the Azores High resulted in a positive 6-mb anomaly near its center.

There were no tropical cyclones this month.

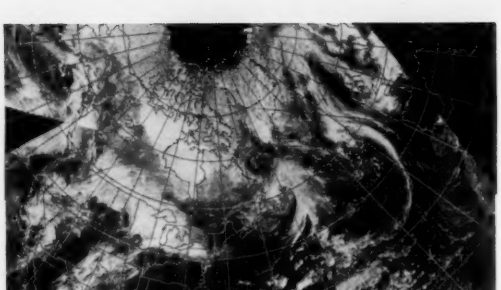

Figure 36.--The LOW was approximately due west of the POSEIDON, about 1500, when the satellite passed over her location. This was of little consolation and aid, at the time, as she battled the storm.

A weak, diffuse depression crossed the Rocky Mountains from the Pacific. In the vicinity of Lake Winnipeg on the 6th, it consolidated and intensified. The pressure was 989 mb. In its eastward movement, it gained in circulation, but did not deepen until over Newfoundland on the 8th. At 0000, the DAWSON was near 42.5°N, 63°W, and was hit by 40-kt winds and 16-ft swells. Twelve hours later, at 1200 on the 8th, the POSEIDON, near 51°N, 45°W, found 50-kt gales and 23-ft seas, but they were not enough for an adventure. Several ships both southeast and southwest of the center reported gale-force winds (fig. 36).

By 0000 on the 9th, the 956-mb LOW was centered near 53°N, 45°W. The pressure had plunged almost 1 mb/hr over the last 24 hr. The Ukrainian ship USNG, 360 mi due south of the center, was battered by 60-kt storm winds driving 26-ft seas. The ERLANGEN, headed east, was fighting 55-kt winds from the south-southwest on her starboard side. The drilling rig VC8062, off Nova Scotia, was being badgered by 50-kt winds and 28-ft seas. The 23°F air temperature did not make life very pleasant. This made a good potential for moderate to severe icing. Ocean Station Vessel "B" had freezing 50-kt northerly winds and moderate snow. On the 1200 chart, many ships were reporting gale winds, but there were no reports within 300 mi of the center, except "B." On the 10th, the BESSTRASHNIJ was headed westward toward Newfoundland and whipped by 60-kt winds. The JOHN CABOT, northeast of Trinity Bay, shivered in 45-kt gales.

On the 10th, a satellite LOW developed in the southeast quadrant and moved northward. On the 11th, the two LOW's straddled the southern tip of Greenland. On the 11th and 12th, the original LOW moved up Greenland's rugged west coast to dissipate in Baffin Bay. The second LOW turned toward the southeast and lost to another even more vicious LOW coming off the continent.

This LOW originated off Cape May early on the 10th and developed rapidly. By 0000 on the 11th, the central pressure had dropped to 974 mb near 43°N, 58°W. The drilling rig VGBZ, midway between the center and the Nova Scotia coast, had a 55-kt blizzard out of

the northeast. Further west off Cape Cod, the USCGC EAGLE battled 50-kt gales. Among others, Ocean Station Vessel "H" measured 40-kt winds, as did the CHARLOTTE LYKES, 900 mi to the east.

Twelve hours later, at 1200 on the 11th, the 956-mb storm was a swirling maelstrom. The report of the CRYOS, southeast of Sydney, Nova Scotia, was a roaring 80-kt, with a thunderstorm. This would appear questionable, due to the low seas reported, but, about 70 mi to the south, another ship plot indicated devastating 75-kt winds, including 36-ft seas. On the southeast side of the LOW (fig. 37), about 250 mi from the center, the AMERICAN ACE was whipped by 55-kt winds on her portside, with 26-ft seas and 30-ft swells. Winds of 35 to 50 kt were blowing from the coast of Maine to about 40°W and south to 35°N.

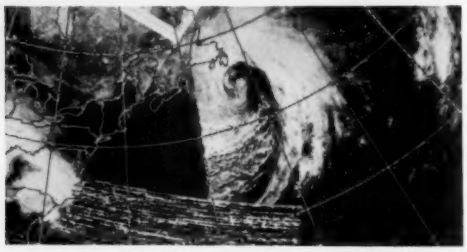

Figure 37.--The swirling cloud mass feeds into the center of the LOW, located south of St. John's, Newfoundland. The area south of Nova Scotia and west of 60°W is not cloudless, but appears so because of satellite readout and computer processing.

The situation had not improved much 12 hr later, as the storm tracked northward and was about 120 mi east of St. John's. A ship near 44°N, 48°W, was headed into 60-kt near-hurricane-force winds at 10 kt. The seas were 38 ft and the swells, 41 ft. The ANCO NORNESS reported a thunderstorm and 55-kt winds near 42.5°N, 46°W, about 150 mi south of the ship. The EDE SOTTORF, MANCHESTER CHALLENGE, and the TATIANA all reported 50-kt winds in various quadrants of the storm.

On the 12th and 13th, the 948-mb LOW circled north of Newfoundland. Its circulation dominated the North Atlantic north of 30°N to 65°N and eastward to 20°W. Ocean Station Vessel "B" was riding out 50-kt winds and 33-ft seas. Four other ships reported 50-kt winds in the southwest corner. There were gale-force wind reports from Kap Farvel south to 35°N, and to 25°W. They were made by the following ships: ACAVUS, ADOLF LEONHARDT, BESSTRASHNIJ, CAROLA REITH, C.P. TRADER, DAWSON, EDE SOTTORF, EVELYN BOLTEN, JOHN A. MACDONALD, MANCHESTER CHALLENGE, MEERKATZE II, SEDCO I, SIDIMI, TAUPO, WARRIOR, WALTER HERWIG, and VGBZ.

The LOW was now in the process of filling as it stalled over Newfoundland. Several small LOW's had formed on its edges, and the gradient was a lot weaker. A newcomer to the scene reported 50-kt winds south of Newfoundland at 1200 on the 13th. By the 15th, the LOW had deteriorated to a trough out of the LOW's that had moved around the edge and were south of Iceland.

High pressure over eastern North America, behind the LOW described above, had pushed the associated front south to parallel the Gulf Coast. During the preceding 24 hr, several waves formed on the front. On the 13th, another wave was analyzed southeast of Cape Hatteras. About 30 mi east of Cape Hatteras, the CARBIDE TEXAS CITY reported 35-kt gales. The LOW rapidly moved northeastward, developing and expanding its circulation as it went. About 0700, the center passed nearly directly over the ESSO FLORENCE, and, at 1200, she was moving against 40-kt gales. Another ship, about 120 mi to the west, reported 45-kt winds.

The LOW was under the upper-air maximum wind band, which was over 130 kt at 500 mb, racing northeastward at 50 kt. By 1200 on the 14th, it was near 46°N, 42°W. The ATLANTIC CHAMPAGNE was ramming into 50-kt bow winds and 20-ft seas south of the center. North of the center, the DART ATLANTIC had 40-kt winds on her stern. Four hundred miles to the south, ahead of the cold front, the C. V. STAGHOUND was on the trail of 45-kt gales.

By midday on the 15th, the storm was northwest of Ireland and had passed south of a smaller system, which was ahead of it and south of Iceland. Three ships reported 45-kt winds; they were the EUROFREIGHTER, Ocean Station Vessel "J," and a ship that could not be identified.

This LOW plus another following close behind fed energy into the semipermanent Icelandic Low, which now started to deepen and became the predominant feature on the 17th, as this LOW was absorbed in the overall circulation. On the 16th and 17th (fig. 38), the ATLANTIC CAUSEWAY, FALSTRIA, and the MARIA L. BOLTEN battled 50-kt winds. The ATLANTIC CAUSEWAY also reported 39-ft swells. About this time, the C. P. VOYAGEUR, London for Quebec, had containers damaged and winch controls washed off the forecastle. At 0000 on the 18th, the central pressure was 962 mb. The NORSE VIKING, near 52.5°N, 35°W, wallowed in 50-kt crosswinds and 33-ft swells.

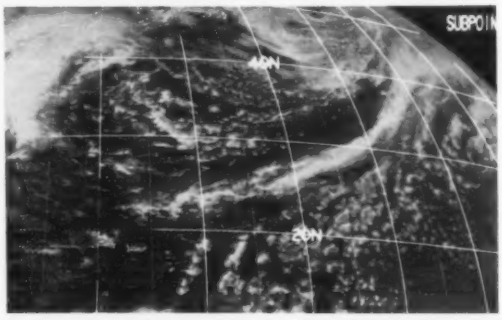

Figure 38.--The energy which supplied the violent weather that damaged the C. P. VOYAGEUR lurks within the storm portrayed in this ATS picture.

The BRUNSWICK was caught by 60-kt winds and 30-ft swells on her bow, near 49.4°N, 20.7°W, just east of a trough line, at 1200 on the 18th. On the 19th, the LOW started weakening and moving eastward. Its demise was rapid as it disappeared from the charts on the 20th.

This was a short-lived storm. An area of low pressure between two high-pressure areas developed into a LOW on the 21st, over the western slopes of the Appalachian Mountains. The LOW moved east and northeastward to east of Portland, Maine, at 0000 on the 22d. At that time, the pressure was 985 mb, and five ships reported 35-kt gale-force winds. Twelve hours later, it was over Anticosti Island, a small but tightly wound storm.

The LOUIS S. ST. LAURENT, in the Strait of Belle Isle, was battered by 60-kt winds out of the southeast. A few miles away, the N. B. MCLEAN had 40-kt gales. The BRUNSWICK and POSEIDON, south and east of St. John's, also found 40-kt gales. As the storm moved northeastward, its center passed over Ocean Station Vessel "B," which reported 40-kt gales after passage. There were no other ship reports in the area. About 1200 on the 24th, the LOW crashed against Kap Farvel and almost split into two centers, but it slid off to the right and moved up the east coast of Greenland. As it passed west of Ocean Station Vessel "A," it treated her to 40-kt winds and snow showers. West of Iceland and still over the Greenland coast, the storm was dissolved by the 26th.

An arctic front extended southwestward out of a LOW in Quebec. It was on the front side of the upper-air trough on the 24th, and waves were forming and moving northeastward along the front. The polar front was further south over the Gulf of Mexico and across northern Florida to a wave off Cape Hatteras. The polar wave moved northeastward off the coast as the arctic front pushed southeastward. By 0000 on the 25th, there were two LOW's; one at 990 mb over southwestern Labrador and the other at 996 mb over Cape Breton Island. At this time, the gale-force winds were associated with the maritime LOW. The ATLANTIC CROWN, ATLANTICA MONTREAL, EXPORT AGENT, and VGBZ all were involved with 40-kt winds.

By 1200, the two LOW's had combined into the northern one, whose pressure had dropped to 975 mb. Ocean Station Vessel "B" now had 40-kt winds. The CRYOS, near 44.5°N, 50.5°W, was reporting 55-kt winds, as the AFOUNDRIA, near 40°N, 55°W, radioed 40-kt gales.

The LOW was still deepening as it moved northward up the Labrador Sea. At 0000 on the 26th, Resolution Island was plotted as being ravaged by 80-kt winds. Ocean Station Vessel "B" had 45 kt and 16-ft seas, while just to the south, another ship reported 40 kt. The LOUIS S. ST. LAURENT, near Corner Brook, Newfoundland, was hounded by 45-kt winds. Twelve hours later, Ocean Station Vessel "B" was still fighting 40-kt gales, but now the temperature had plunged to 16°F, the seas were 18 ft, and they reported 0.4 in of ice from spray, and slowly building. It was not the only ship with icing problems. The POSEIDON, about 200 mi east of Belle Isle, reported 0.8 in of ice from spray, but not increasing. There were no further reports plotted from Resolution Island, but, 12 hr later, Frobisher reported 30-kt from the northwest. At 0000 on the 27th, "B" again had 45-kt gales and 16-ft seas, but no report on ice. The temperature was still down to 21°F. As the front passed, Ocean Station Vessel "A" reported 35-kt winds and 15-ft seas, with 10-ft swells.

As the LOW reached Frobisher Bay, it stalled and started to fill. Later, it moved toward the northwest and over Foxe Basin.

As a high-pressure area moved across the eastern United States, it fed warm, moist air into the midwest and plains States. A frontal system developed over the northern plains between the warm, moist air from the south and the cold, dry air from the north. A LOW formed on the front on the 25th. The LOW moved eastward behind the HIGH, developing rather slowly. At 1200 on the 27th, it was 990 mb over Nova Scotia. At that time, the GAUSS, near 39°N, 58°W, and the ST. MARGARET, near 41.5°N, 66°W, both reported 40-kt gales. To the north, just off Cape Sable, the VIGILANT was battling 28-ft seas and swells.

Twelve hours later, as the LOW moved over water, the central pressure continued to drop to 978 mb, and the wind speeds increased. The highest winds were measured by three drilling rigs--SEDCO I, 60 kt; VC8062, 60 kt, with 33-ft seas and 1.2 in of ice from spray increasing slowly; and VGBZ, 55 kt and 25-ft seas. Due south of the LOW, which was over Argentia, the ABIDA was plowing into 45-kt gales. Gale-force winds were reported up to 600 mi out in the southern quadrants.

The LOW was moving slowly northeastward as its pressure continued to drop and the area of high winds increased. At 1200 on the 28th, the DLPC, at 45.7°N, 52.3°W, struggled with 55-kt winds. The ABIDA, SULAPHAT, and VC8062 all had 50-kt winds. The VC8062 was still reporting 28-ft seas, and the ice had built to 1.6-in thickness (fig. 39). At 0000 on the 29th, SEDCO I was again hit by 60-kt winds.

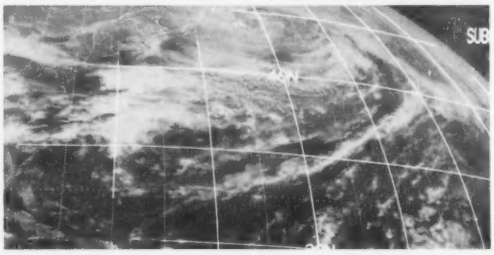

Figure 39.--It is possible to visualize the cold air as it pours out of the frigid interior and brings high seas and icing to the Grand Banks area.

The circulation from the LOW now covered most of the Atlantic from shore to shore north of 40°N. At 0000 on the 29th, the lowest pressure of 960 mb was analyzed. SULAPHAT was still fighting the high winds as she moved westward. The AMERICAN LEGACY was now added to the 50-kt club, near 52.5°N, 32°W. Ocean Station Vessel "A" was fighting 55-kt freezing winds and 30-ft seas. Ocean Station Vessel "B" had 40-kt winds for over 24 hr.

On the 30th, the LOW had curved toward the east and was filling, but it still was able to deliver 50-kt winds to the KJVG. On the 31st, it again turned northward and, by the 1st, was centered near Ocean Station Vessel "A," where it remained until it blended into another system.

Casualties--The 12,700-ton Liberian-registered YOSEMITE broke adrift in a strong current in the Savannah River on the 6th and ran aground. The

Figure 40.--The Navy frigate DAHLGREN appears to have come out second best in the collision with the EGERIA during dense fog over Chesapeake Bay. Wide World Photo.

attempt to rescue the 6,858-ton British oil-well maintenance vessel OREGIS, which had run aground on rocks in the Tyne River during a storm, was abandoned. It was determined the ship had broken her back. A Russian fishing vessel, the MORSHANSK (684 tons), sank after a collision with the Greek NATAL (8,849 tons) in fog off Texel Lighthouse, Netherlands. A LOW that moved up the U.S. east coast on the 17th must have generated the winds that caused the German LINDO to strike the tug HELEN MCALLISTER about 10 mi south of Fire Island. The tug received a gash amidships and listed 15° to port.

The 3,332-ton British motorvessel GINA MARIA arrived Veracruz on the 19th from Antwerp with a damaged starboard due to heavy seas, which pushed in 80 ft of gunwale.

The Navy destroyer DAHLGREN (fig. 40) collided with the 40,695-ton Italian tanker EGERIA (fig. 41) in fog off the Hampton Roads bridge and tunnel. There were no injuries. The 381-ton Dutch motorvessel SPRAY was caught in ice about 250 mi southwest of St. John's, Newfoundland. Shell plating was damaged, but she was not taking water as she drifted southward in northerly gales. The vessel was unable to use propeller in the ice and requested assistance.

Figure 41.--Compared to the superstructure damage on the DAHLGREN, the damage to the bow of the EGERIA appears slight. Luckily, there were no injuries involved. Wide World Photo.

Rough Log, North Pacific Weather

February and March 1974

ROUGH LOG, FEBRUARY 1974--The monthly cyclone track chart was near normal. The number of cyclones may have been slightly below normal, but the difference was a traffic jam off the southeast coast of the Kamchatka Peninsula. The primary track extended from central Japan to the Gulf of Alaska. There were a few mavericks, but they were generally not significant. An additional discrepancy from normal was the lack of storm centers south of Portland, Oreg.

The climatic mean sea-level pressure chart indicated a 1000.3-mb Low about 51°N, 172°E; a 1020.8-mb High near 31°N, 138°W; a ridge of high pressure extending out of the Siberian High across Okinawa, along approximateiy 25°N to near the Date Line; and a series of small Highs over the United States and Canada. On this month's mean-pressure chart, the Highs were normally located, but the one off the U.S. west coast was about 4 mb higher in pressure at 1025 mb, as was the pressure over the western United States at 1023 mb. The Aleutian Low was split into two centers, one southeast of the Kamchatka Peninsula near 48°N, 160°E, at 1001 mb, and the other in the Gulf of Alaska near 57°N, 148°W, at 995 mb.

The anomalies, of course, were associated with the departures from the climatological mean, both in location and value. The largest was a negative 16 mb in the northern part of the Gulf of Alaska. The Low center that was just off the Kamchatka Peninsula did not produce a large anomaly; in fact, its displacement produced a positive anomaly ridge out of Siberia, south into the Bering Sea. The central eastern half of the ocean--20°N to 40°N and 180° into the United States--was dominated by a large positive anomaly with three centers, two of 5 mb and the central one of 6 mb.

There were no tropical cyclones in the North Pacific this month. None would be expected in the east, but there is an average of one tropical storm every 4 yr in the west, and about one of these will reach typhoon intensity every 15 yr.

During the first 10 days of the month, a large high-pressure area dominated the eastern North Pacific off the U.S. west coast. Only two relatively weak LOW centers penetrated the Gulf of Alaska, and one of these on the last day. The storms during the first part of the month were fewer than usual and weak except for the monster, which dominated the scene.

The first LOW was not a viscous one, but deserves mentioning. It came alive on the 6th. A front was south and east of Japan, oriented more or less east-west. Small waves were forming and dissipating, but this one developed further east and continued strengthening. At 1200, the SURUGA MARU caught 40-kt winds just a few miles south of the 999-mb center. Twelve hours later, the EISHO MARU was treated to heavy rain and 50-kt winds, as the front passed her position near 34°N, 159°E. Winds of 35- to 40-kt were now being reported 400 to 500 mi to the east and west of the center.

The LOW had traveled to 42.5°N, 176.5°W, by midnight on the 7th. The RONA and another ship reported 50-kt northerly gales west of the center. The MANDARIN VENTURE, just east of the front, south of the center, also found 50-kt gales. The SANTA CATALINA MARU, at 39°N, 172°E, which was about 400 mi behind the cold front, reported only 30-kt northerly winds, with 8-ft seas, but the swells were 36 ft from 240°.

The storm now took a more northeasterly than northerly course, and, by 0000 on the 9th, overtook and absorbed another LOW which was over the Aleutians. The cyclonic circulation was now larger, but the winds were not as strong. The LOW tracked up the island chain and was over the Kenai Peninsula on the 10th. Gale winds were widespread over the Gulf of Alaska, but the highest plotted were two 40-kt reports. The LOW idled in the northern Gulf until the 15th, when it again started moving eastward under upper-air influences.

Monster of the Month--This most severe storm of the month developed in a low-pressure trough that deepened as it moved across Japan on the 7th. The LOW deepened very rapidly to 972 mb, near 39°N, 147°E, by 1200 on the 8th. The SITKA MARU, northeast of the center, ran into heavy rain and storm winds of 60 kt. South of Shikoku, the CATHAY had only 40-kt winds, but waves from three directions. An unidentifiable ship reported 45-kt, south of Tokyo.

Twelve hours later, the winds were really roaring. Gale-force and higher winds extended out to 600 mi to the south and east, and over 400 mi to the northeast. The BRIS and SANDAR, both south of the LOW, were battered by 60-kt winds. The HONSHU MARU, about 300 mi to the northeast, had heavy snow and 50-kt winds. The KIKUTAMA MARU, about 200 mi south of the center, had 50-kt winds and 31-ft seas.

At 1200 on the 9th, the LOW had a pressure of 954 mb, near 42°N, 153°E. The SHOGEN MARU, at 45°N, 163.5°E, found another 60-kt band of winds, and the KIKUTAMA MARU was still battling 50-kt winds and 30-ft seas on her easterly course. The LOW was still deepening and spreading on the 10th, with its circulation pattern (fig. 42) covering the area from Korea to 180°. The MARITIME ACE reported 50-kt winds, 25-ft seas, and 28-ft swells, about 140 mi east of Ostrov Paramushir, which was reporting 70-kt winds. South of the 952-mb center, the SHINKYO MARU was being pushed along by 55-kt winds, driving 38-ft seas and 25-ft swells. At 1200 on the 10th, the LOW was turning northward, with Ostrov Paramushir still suffering from a 65-kt blizzard.

On the 11th, the LOW was moving slowly north-

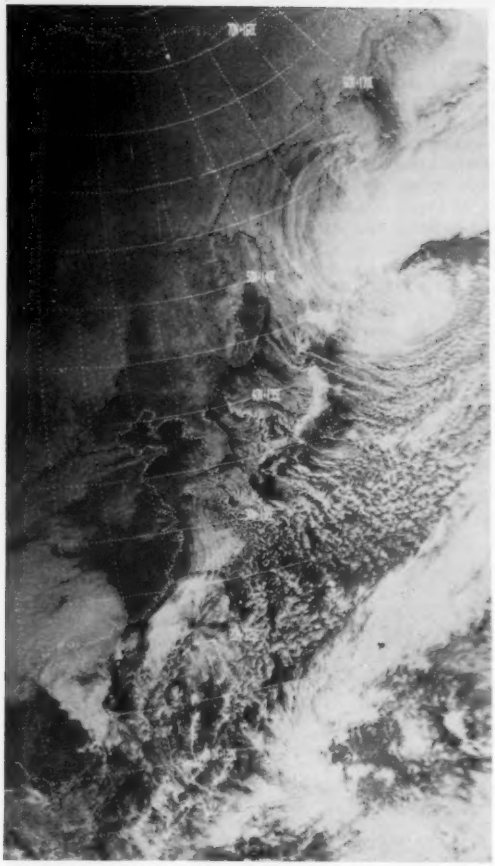

Figure 42.--All of the monster is not visible in the coverage from this one orbit. Part of the frontal cloud pattern and circulation is cut off on the eastern edge. The cold air swirls southward out of Arctic Siberia to chill Japan.

ward along the Kuril Islands. The pressure was slowly rising, so the gradient relaxed a little. Gale-force winds were plotted as far east as 170°W and south to 30°N. The MOSKALVO, near Ostrov Urup, was blown by 50-kt winds. Minor LOWs were now forming on the periphery of the circulation, as the major center wandered in the area off the southeast coast of Kamchatka. Ostrov Simushir reported 60-kt winds. The report by the PENEZHINA, near 55°N, 154°E, in the Sea of Okhotsk, at 1200 on the 12th, was decoded to read a roaring 70 kt. Twelve hours later, the island of Simushir measured 50-kt winds. The LOW continued filling and, at 0000 on the 14th, was 982-mb.

The satellite LOWs continued to form and move around the edge. At 0000 on the 13th, one of the stronger ones formed near northern Honshu. Twenty-four hours later, it was at 40.5°N, 163°E. Gale-force winds were blowing around its southern quadrant.

Figure 43.--By late on the 19th, when this satellite orbit occurred, the LOW had raced toward the Gulf of Alaska to harass shipping there. Note that the coordinates are slightly off on the grid.

Forty-five-knot gales were reported by the KUROBE MARU and the NEW JERSEY MARU, south and southwest of the center. Twenty-four hours later, both were still being hit by 40- and 45-kt gales, as they approximately paralleled the storm's track.

This was now becoming the dominant storm, as the old LOW filled. The pressure had dropped to 970 mb. On the 16th, this had become the main circulation across the Northern Pacific. At 0000, it was located at 47°N, 178°W, and moving very slowly toward the northeast. Although the winds in this storm did not get exceptionally high, they were widespread. The storm continued east-northeastward, with isolated maximum winds of 35 kt, into the Gulf of Alaska, where it filled on the 20th.

This was the second most powerful storm over the North Pacific this month. It began late on the 15th, northeast of Tokyo. It developed slowly as it moved eastward. The first gale-force wind was 35 kt, reported at 0000 on the 17th by the REINHART LORENZ RUSS, near 34.5°N, 160°E, about 100 mi south of the 1006-mb center.

Near midocean on the 18th, the pressure had dropped to 985 mb. On the 19th, the PRESIDENT GRANT was hit by 40-kt gales, near 38.5°N, 162°W, about 250 mi south of the center (fig. 43). The LOW was racing toward the Gulf of Alaska and the semipermanent LOW that had established itself there. This reinforced the already present LOW. At 1200 on the 20th, the ALASKAN MAIL (55°N, 149°W) and the

SERGEY YESENIN (51.5°N, 160°W) both reported 45-kt gales. On that chart, a small LOW developed at the occlusion and raced toward the center, again increasing the gradient and circulation. A station on Queen Charlotte Island measured 60-kt winds. The ARCO PRUDHOE BAY, at 59°N, 151.7°W, found howling 55-kt winds. Winds of 35 to 45 kt were widespread. Ocean Station Vessel "P" measured 40-kt winds and 25-ft seas. Twelve hours later, she still had the same winds and seas, with added 30-ft swells. Kodiak, Alaska, suffered its highest wind of the month of 48 kt, with a maximum gust of 55 kt.

On the 22d, the LOW was filling and weakening, and, on the 23d, another LOW came in from the southwest to intensify the system again.

A strong earthquake rocked the Aleutian Islands on the 5th. It registered 6.3 on the Richter scale, and its epicenter was about 70 mi east of Unalaska. On the 11th, the SUMMIT reported that the volcano on Akutan Island was in a state of eruption. Volcanic ash and debris were spewing several hundreds of feet into the air, and molten lava was flowing down the side. The volcano is located about 45 mi northwest of where the earthquake was recorded.

Casualties--The American CANADA BEAR (8,739 tons), for Tacoma, returned to Brisbane on the 7th with heavy weather damage. Five containers were lost overboard, and 12 sustained damage. A Republic of Korea Navy tugboat carrying 316 men capsized and sank in rough seas off South Korea's southern coast on the 22d. It was reported that 157 men were rescued.

ROUGH LOG, MARCH 1974--There was an abundance of extratropical storms this month. The primary tracks out of Asia were normal, but the track across the water was much further south, rather than along the Aleutian Islands and into the northern Gulf of Alaska. The primary west-to-east track was between 35° and 45°N in the western ocean and between 40° and 50°N in the eastern ocean. There was also a secondary track which branched off northward into the Bering Sea.

The mean pressure centers were displaced southeastward. The 1005.3-mb Aleutian Low, which is located near 52°N, 167°E, according to climatology, was 995 mb near 47°N, 178°W. The Pacific High was about 1 mb lower than normal, at 1021 mb, and centered near 25°N, 130°W, or about 1,000 mi southeast of its climatic location.

The major displacements resulted in a large negative anomaly center of 17 mb near 42°N, 173°W. A negative 8-mb subcenter was located off the Queen Charlotte Islands. A positive 5-mb anomaly center was located west of Cabo Falso near 23°N, 120°W.

There was one tropical storm--Amy--in the western North Pacific and none in the eastern North Pacific.

The first week of this month, the North Pacific was cut up by many relatively small pressure centers. The only large pressure feature was the eastern North Pacific High, which was centered between Hawaii and Seattle. On the 4th, a small LOW formed in a trough off Yakatat, Alaska. The gradient tightened rapidly, and the ESSO NEWARK was running into 50-kt winds and 33-ft swells at 0000 on the 5th. At 1200, the GALVESTON, further north near 58°N, 147°W, also fought 50-kt winds, 16-ft seas, and 30-ft swells. By 0000 on the 6th, the LOW had dissipated back into a trough again.

At 1200 on the 7th, another LOW formed in the semipermanent trough, south of Montague Island. This LOW remained quasi-stationary and deepened as several transient LOWs moved around the southern circumference. At 1200 on the 8th, the J.H. TUTTLE had 45-kt winds off her bow, south of Kodiak Island. Twelve hours later, the YOCONA reported 50-kt winds and 49-ft seas just south of Cape Flattery. The minor waves had been moving eastward south of the center and crashing into the Alaska-British Columbia coast, about one per day (fig. 44). The LOW gradually drifted southward and, at 1200 on the 10th, was near 50°N, 139°W. At that time, the SUMMIT was near 55.5°N, 157.5°W, and was hit by 60-kt northerly winds. On the other side of the LOW, the Portland Lightvessel had 40-kt southerly winds. The LOW gradually drifted eastward and was filling, and there were isolated reports of gale-force winds. On the 13th, the LOW had two centers; the new one was just south of the Kenai Peninsula. By the 14th, the LOW had disappeared.

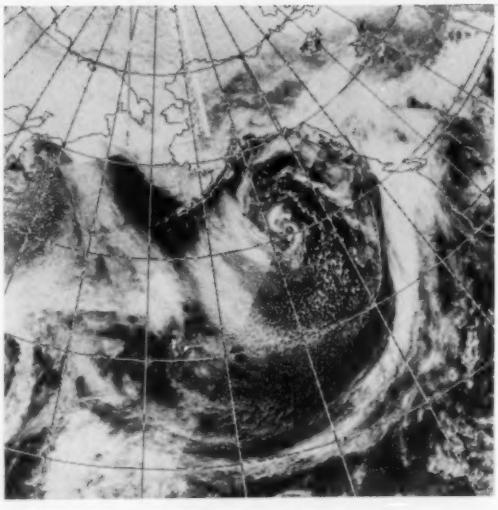

Figure 44.--The clouds near the center of this extratropical cyclone form the weather map symbol for a tropical cyclone as they feed into the center.

This was part of a train of LOWs that were developing near Japan and running east toward the southern Gulf of Alaska. This 1003-mb LOW formed further east, near 35°N, 163°E, late on the 8th. The LOW just ahead of it had generated 50-kt winds for the GREISHAM (44.5°N, 174°E) and the KEIKO MARU (53.5°N, 178°W).

In the next 24 hr, the LOW traveled northeastward and intensified with gale-force winds. At 0000 on the 10th, it brought 45-kt winds to the BREMEN MARU

and the TOKUSHO MARU, south and west of the center, respectively.

At 1200 on the 10th (fig. 45), the Russian vessel PRIBOI, near 41°N, 175°E, measured 60-kt storm winds from the north, with heavy rain, while 12 hr earlier she had been basking in 10-kt southeasterly winds at a more northerly position. At 0000 on the 11th, the DAISHIN MARU also found 60-kt winds about 60 mi northwest of where the PRIBOI reported them. The system now had a double center, as a secondary LOW formed near the triple point. The two LOWs again combined into one, with a pressure of 973 mb. The ONXE found 50-kt winds near 48°N, 179.5°E, with 20-ft seas.

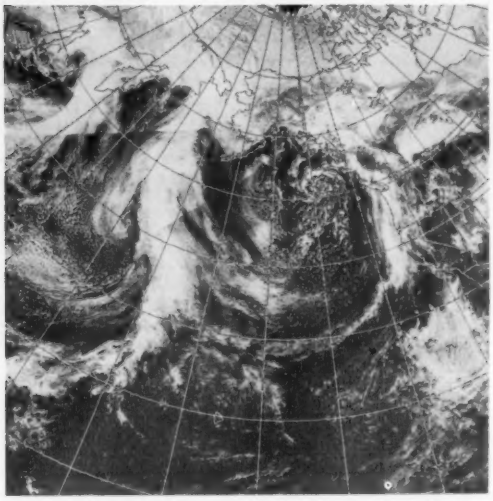

Figure 45.--The LOW was located near 40°N, 178°W, at this time. Approximately 24 hr earlier, the LOW can be located near 38°N, 172°E, on the previous picture. The cloud pattern in the LOW in the Gulf of Alaska no longer forms the tropical cyclone symbol.

The LOW had been pushing against a high-pressure ridge which extended southward over the Bering Sea. The high pressure was building southward and forced the LOW on a southeasterly track. The central pressure of the LOW was rising even though its area of cyclonic circulation expanded all the way to the U.S. west coast. Only minimal gales were being reported.

On the 14th, the 988-mb LOW turned northeastward again as it moved closer to the coast. It moved over the Queen Charlotte Islands late on the 16th and dissipated.

Earlier, a LOW had moved out of the Sea of Japan into the Sea of Okhotsk and straddled the Kamchatka Peninsula. A trough from this system extended southward off the east coast of Japan. The southern part was very weak, and, on the 11th, a LOW formed in the bottom of the trough. By 1200 on the 13th, the 984-mb LOW was at 43°N, 165°E. The PRIBOI, near 45°N, 170°E, measured 40-kt winds northeast of the center. Gale winds were found as far as 850 mi to the southwest and 750 mi to the south. The DAISHIN MARU reported thunderstorm activity. Twelve hours later, the DAIAN MARU had 50-kt gales, as the storm center passed just east to north of her position. That was only the beginning. Twelve hours later, at 1200 on the 14th, she was hit by 60-kt winds, as the ship moved northeastward and the storm northward. The seas were 16 ft and the swells, 30 ft. North of the center, the KATHRYN MARU was rocked by 50-kt winds. At 0000 on the 15th, another ship was hit by 50-kt winds within a few miles of the center (fig. 46).

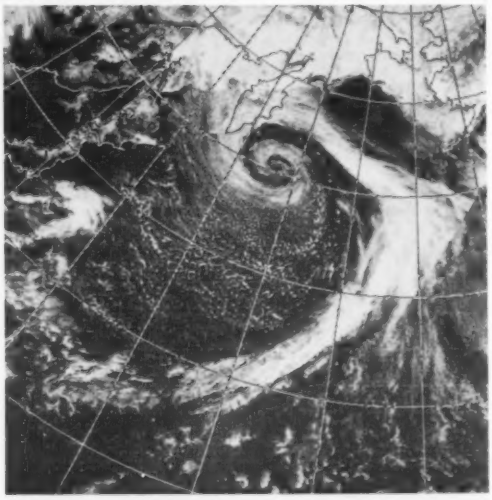

Figure 46.--The cloud bands with the clear areas between clearly define the wind bands as they spiral into the center. Note the honeycomb patterns in the clouds south of the LOW.

Late on the 15th, another LOW center developed on the occlusion and moved to a position east of the old center. This relaxed the gradient, as the circulation stretched east-west. Gale-force 35- to 40-kt winds were spotted around the circulation. As is the usual case when a subcenter develops, the pressure started to increase. The path of the center traced a loop east of Kamchatka and was absorbed by another weather system on the 17th.

Monster of the Month.--This small LOW was first picked up on the 18th, just southeast of Tokyo. Tropical storm Amy was about 800 mi to the south and moving east-northeastward. As Amy weakened and dissipated, this LOW developed. By 1200 on the 20th, the 978-mb extratropical LOW had absorbed all traces of the tropical LOW, except a ship report of high seas. About 250 mi southwest of the center (36°N, 162°E), the TOYOTA MARU No. 11 ran into 45-kt gales. North and east of the center, the KAKO MARU and the BREMEN MARU fought 40-kt gales. On the 21st, the OCEAN BRIDGE, about 700 mi to the southeast near

a small transient LOW, was battered by 50-kt southerly winds.

Twelve hours later, the central pressure of the LOW was 964 mb, near 39°N, 178°E. There were no reports within 300 mi of the center, but, to the south and southwest, the LITIJA had 55-kt winds on her starboard side, with 18-ft seas and 20-ft swells. The GOLDEN GATE BRIDGE and another ship reported 50-kt winds and 27-ft seas.

The winds were increasing in speed and area. The MONDO, 350 mi due south of the center, was slowly cruising into 60-kt storm winds with 21-ft seas and 30-ft swells. Southwest of the center (fig. 47), three ships had winds of 50 kt or greater. They were GOLDEN GATE BRIDGE, WARYU MARU, and another ship. The WARYU MARU reported 30-ft seas and swells. The 8,373-ton Cypriot ELNA, Los Angeles for Yokohama, reported encountering severe weather about 1,000 mi northwest of Hawaii. Twelve hours later at 1200 on the 22d, a ship 900 mi south of the center was battered by 50-kt winds and 31-ft seas. The GUAM BEAR, about the same distance to the southeast, also had winds of 50 kt. The seas were not high, but were from mixed directions.

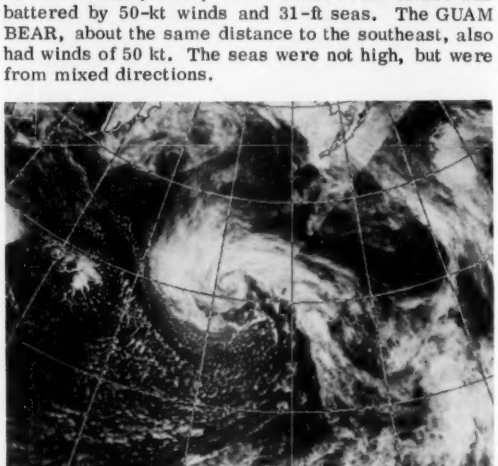

Figure 47.--With a good imagination, the storm looks like a monster in this satellite composite. The scattered cloud cover south of the LOW has the appearance of fairweather cumulus, rather than the violent winds and seas that were actually present.

At 0000 on the 23d, three ships reported 60-kt winds and anything but pacific seas. The UNION EXPANSION had 16-ft seas and 41-ft swells, the ZIM NEW YORK had 36-ft seas and 39-ft swells, and the JGFM had 16-ft seas and 30-ft swells. The ESSO BRASILIA, HAWAII BEAR, and the VOLNAY all encountered 50-kt winds, with the BEAR fighting both 49-ft seas and swells. On the 23d, the pressure reached its lowest of 952 mb. There were no reports within 600 mi of the center at 1200, but the JFZG, which was 650 mi southwest of the center, radioed 45-kt winds, 26-ft seas, and 46-ft swells near 32°N, 173°W.

Early on the 24th, the center split into two LOWs, with a third approaching from the west. There was only one report of winds as high as 60-kt, by the MARGARET CORD, near 34°N, 168°W, with 33-ft seas. The maximum wind band was over 600 mi south of the centers, between 27°N and 37°N. The exception was miles east of the system, ahead of the front. Ocean Station Vessel "P" was receiving 45-kt gales, and the TURANDOT, near 46°N, 145°W, had 50-kt winds.

On the 24th, this was the only major circulation system in the North Pacific. It stretched from Japan to California. There were three small HIGHs in the low latitudes, but they were flat with weak circulations. On the 25th, the three centers combined into one, but another LOW had formed on the western edge. The most severe wind speeds had decreased, with the 50-kt report of the UNION EXPANSION, near 35°N, 175°W, being the highest. Sea and swell reports of 15 to 25 ft were common, with the long fetch and relatively straight flow. Most of the gale reports were between 30° and 40°N.

On the chart of 0000 on the 26th, the area of 50-kt winds had moved eastward. The JAG ANJLI, near 38°N, 161.5°W, had 50-kt winds. For the rest of its existence, there were only isolated reports of minimum gale-force winds. The LOW's track turned northward on the 25th and westward on the 27th. It continued westward to the vicinity of Adak Island on the 29th, where it was lost on the charts.

During this period, many other LOWs developed and faded, passing through the pressure system, but an effort was made to track the original center. At times, it was not the center of lowest pressure.

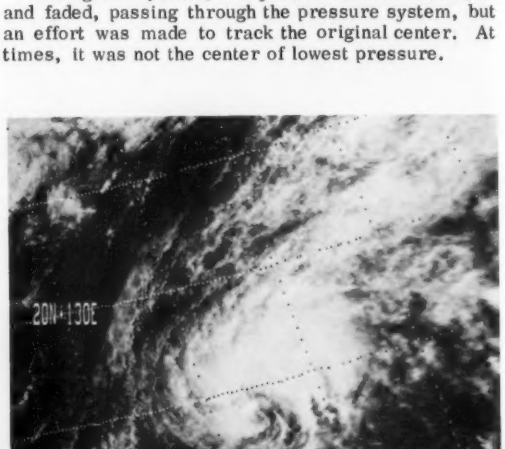

Figure 48.--Amy was approaching tropical storm intensity at 0024 on the 17th. At that time, her center was near 13.8°N, 137°E.

Tropical storm Amy, the second western Pacific tropical cyclone of the season, formed some 300 mi south of Guam on the 14th. She remained a tropical depression for the next 3 days. Amy headed west-northwestward, but recurved after passing Yap Island. She became a minimal tropical storm on the 17th, near 15°N, 138°E (fig.48). At this time, Amy was heading northeastward. Winds of 35 kt, with gusts to 45 kt, blew around her center. On the 19th, as she was in the process of turning extratropical, sustained winds jumped briefly to 45 kt. Amy finished her extra-tropical transformation later in the day, as she passed close to Marcus Island.

Casualties--A collision in dense fog at Inchon, Korea, on the 8th, damaged the 16,832-ton Taiwanese bulk carrier EVER HONOR and the 3,818-ton South Korean INCHON.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

Marine Weather Diary

NORTH ATLANTIC, JUNE

WEATHER over the North Atlantic is usually very pleasant in June. The number of active extratropical LOWS continues to decline, and storms are usually confined to higher latitudes. The building Azores High averages near 1024 mb for the month and is centered over midocean near 33°N, 38°W. The Icelandic Low, oriented east-west, is quite diffuse with the lowest average pressure about 1010 mb, just off the coast of Labrador.

WINDS are controlled largely by the Azores High. Between 25° and 55°N, southwesterly winds predominate, except over the eastern ocean from the Bay of Biscay southeastward, where northerly winds prevail. South of 25° to about 5°N, the "northeast trades" are generally steady. North of 55°N, winds are mostly variable. On the Mediterranean, east to southeast winds are common over the western half, while northwest winds blow steadily over the eastern portion. Northwesterly winds prevail over the eastern Gulf of Mexico while southeasterly winds are predominant over the southern North Atlantic between the Equator and 5°N. Wind speeds over most of the North Atlantic during June are force 3 to 4. Lighter force 2 to 3 winds are most common over the Mediterranean Sea, Davis Strait, Gulf of Mexico, Bay of Biscay and waters southwestward, and near the Equator.

EXTRATROPICAL CYCLONES are fewer in June than in May and not as intense. Cyclogenesis throughout the summer occurs principally in the area from the Carolinas, west of 65°W, to Hamilton Inlet, Labrador, west of 50°W; north of Scotland; northwest of Iceland; over the waters southwest of the British Isles; and over the Gulfs of Finland, Riga, and Bothnia. The major storm tracks during June extend from the Newfoundland area northeastward to the waters south of Iceland and then northeastward across the Scandinavian Peninsula. Another primary track extends from Iowa across central Lake Michigan to southern Lake Huron and down the St. Lawrence River where it joins a track that develops off Cape Cod.

GALES over the North Atlantic are infrequent during June. Only in the waters near southern Greenland and over northern portions of the Norwegian Sea does the probability of encountering gales exceed 10 percent.

TROPICAL CYCLONES. Tropical storms average about one every 2 yr. The preferred area of tropical cyclone formation is over the western Caribbean and the Gulf of Mexico. The 43-yr period, 1931-73, had 24 tropical storms, of which 11 reached hurricane strength.

SEA HEIGHTS of 12 ft or more occur between 5 and 10 percent of the time northward of a line drawn from east of the Grand Banks to west of Ireland, and west of a line drawn from west of Ireland to the southern boundaries of the Norwegian Sea and then south of Iceland to the Denmark Strait. Other smaller areas encompass the waters between Norway and the Shetland Islands, the waters off the central Norwegian coast, and the Gulf of Lions. Frequencies reach 10 percent or more only over an elliptical area immediately south of Kap Farvel.

VISIBILITY. The frequency of fog approaches its maximum over the northern ocean. The Grand Banks is the foggiest region--visibility below 2 mi is reported on more than 30 percent of all observations. The percentage of this low visibility decreases to between 20 and 30 percent of the observations over the Davis Strait and the northern Labrador Sea and over the waters east of Kap Brewster, Greenland. The latter area is usually ice-covered at this time of year. The fog is generally observed in warm, moist air brought by southerly winds into this area of cold ocean temperatures.

NORTH PACIFIC, JUNE

WEATHER. The summer regime is well established over the North Pacific in June. Vigorous extratropical storms are less frequent than in May. The subtropical High is centered near 36°N, 149°W, and has an average central pressure of about 1024 mb. The Aleutian Low, located north of the western Aleutian Islands, fills rapidly during June; by the end of the month, it has disappeared.

WINDS north of 25°N are somewhat variable, but southerly to southwesterly winds are most abundant with a few exceptions. Westerly to northwesterly winds prevail over the waters surrounding the western Aleutians and the Komandorskiye Islands. Northwesterly winds also prevail east of 140°W (north of the 40th parallel), and winds from the northeast quarter of the compass predominate east of 160°W (north of the 30th parallel). Wind speeds average force 3 to 4 north of 25°N. South of 25° (30° east of 145°W) to the Equator, steady "northeast trades" dominate, with force 4 the most common wind speed reported. On the South China Sea, however, the southwest monsoon is well established and southerly winds prevail. These winds average about force 3. Winds out from the Gulf of Tehuantepec usually blow from the northern semicircle, and 53 percent of all winds are force 2 or 3.

EXTRATROPICAL CYCLONES. The most favorable area for cyclogenesis continues to be east of Honshu. The primary storm tracks lead from here east-northeastward to the Gulf of Alaska. Another track approaches the Gulf of Alaska on a northeasterly course from midocean.

GALES are rare in June. Only over a small area near 46°N, 145°W, does the chance of encountering gales exceed 5 percent.

TROPICAL CYCLONES. The probability of tropical storm development continues to rise sharply in June, approaching the late summer and early fall maximum. On the average, three of these storms develop per year--one or two during this month in Asiatic waters and one or two over the ocean area between 10° and 20°N and the Mexican west coast and 120°W. About two out of three western North Pacific tropical storms go on to become typhoons. One out of three eastern North Pacific storms reach hurricane intensity.

SEA HEIGHTS of 12 ft or more have a frequency greater than 10 percent only in two small areas. One is centered south of the Alaska Peninsula near 48°N, and the other south of the western Aleutians near 46°N. In general, sea conditions are considerably improved over those of May.

VISIBILITY. The frequency of low visibility increases over most of the North Pacific. The waters east of the northern Kuril Islands are particularly foggy, with the visibility dropping below 2 mi in over 40 percent of the observations. From the outer boundaries of this area northward to Kamchatka, southward to the the central Kurils, westward to the eastern Sea of Okhotsk, and eastward to 162°E, this percentage drops to 30 to 40 percent of all observations. The area of this low visibility, which encompasses 20 to 30 percent of all observations, extends from the southern Sea of Okhotsk through the central Kurils and then eastward through the North Pacific along the 40th parallel to 165°W. The line bordering the boundary of the area then bends westward to midocean near 47°N, 175°E, before curving northeastward through the central Aleutians to St. Lawrence Island in the Bering Sea.

NORTH ATLANTIC, JULY

WEATHER conditions are relatively settled during July as the Azores High, centered near 35°N, 44°W, builds to a seasonal maximum of about 1025 mb, and primary storm tracks are displaced north of 45°N. The Icelandic Low remains an ill-defined east-west trough with the lowest pressure, about 1009 mb, centered near Hudson Strait in eastern Canada.

WINDS over the middle and northern latitudes have southerly and westerly components. Northerly winds are common near the entrance to the Mediterranean, while over the Sea itself northwesterly winds are steady. Winds from the northerly quarter are found over the North Sea, off the central Norwegian coast, and over the Davis Strait and the waters southwest of Iceland. The "northeast trades" blow between 10° and 25° N, while in the Gulf of Mexico easterly winds are most frequent. Near the Equator, southeasterlies dominate the area between South America and Africa. Wind speeds average about force 3 to 4 over most of these areas except over the Mediterranean Sea, the Davis Strait, and the Gulf of Mexico where force 2 to 3 winds are prevalent. The strongest winds, of which nearly two-fifths of all observations are force 5, are encountered over the waters of the southwestern Caribbean Sea.

GALES. The frequency of gales is at a minimum for the year. Only over the Norwegian Sea is the percentage frequency of gales 10 percent or higher.

EXTRATROPICAL CYCLONES. From June to July, a marked northward shift of cyclonic activity occurs over the North Atlantic. Areas of cyclogenesis are along the North American coast from the Carolinas to north of Newfoundland, in the Denmark Strait, southwest and north of the British Isles, in the Adriatic Sea, and over the Gulfs of Bothnia, Finland, and Riga. The primary cyclone tracks lead from the Hudson Bay region northeastward through the Davis Strait, from the Grand Bank and the Gulf of St. Lawrence toward Iceland, and from north of Scotland eastward across southern Scandinavia. Two secondary tracks cross the Great Lakes. One extends from the Great Plains across eastern Lake Superior toward Labrador, while the other cuts an east-northeasterly swath across Lakes Erie and Ontario, New York, and New England before merging with the Carolina storm track over the Gulf of St. Lawrence.

TROPICAL CYCLONE activity in the North Atlantic is still limited during July. During the 43-yr period, 1931-73, 35 tropical storms have been logged, and 18 of these have reached hurricane force. July tropical cyclones usually originate over the Gulf of Mexico or just east of the Lesser Antilles. Those forming over the Gulf generally move northward across the Gulf Coast, while those born east of the Lesser Antilles may move westward across the Caribbean Sea or northwestward toward the southeast coast of the United States where they often recurve to the northeast. Sometimes these storms are bred north and east of the Bahama Islands during July.

SEA HEIGHTS of 12 ft or more are encountered with a frequency of 10 percent or more only in a small area immediately south of southern Greenland.

VISIBILITY. Like June, July is one of the foggiest months of the year over the western North Atlantic. Observations with visibility less than 2 mi average 10 percent or more northward of a line drawn from the waters between Cape Cod and Cape Sable northeastward to near 60°N, 30°W. From there the 10-percent frequency line runs eastward, south of Iceland, to near the Faeroe Islands and then southward, cutting across Scotland near the Firth of Forth. The line then extends northward along the Prime Meridian to about 63°N, where it heads northeastward to the coast of

Norway. The 20-percent frequency line is a little less erratic. It extends from near Cod Island, Labrador, eastward to near 56°N, 47°W; it then extends southwestward across Newfoundland to the Grand Bank. From there, visibilities less than 2 mi occur 20 percent or more of the time west of a line drawn to the coastal waters of Greenland, near Kap Mosting, and then north of the same line extended to 74°N, 20° E. Enclosed within the area defined by Godthaab (Greenland), Resolution Island, and Ivigtut(Greenland), observations with visibility less than 2 mi exceed 30 percent.

NORTH PACIFIC, JULY

WEATHER. The steady and rather settled summer weather conditions that commenced in June over the North Pacific become widespread and firmly established during July. The Aleutian Low has disappeared from the pressure chart of normals,and the subtropical High, with a pressure of 1026 mb, has moved northward to near 38°N, 150°W.

WINDS. Because of the strong development and northward position of the subtropical High, the "northeast trades" extend over a large portion of the ocean. They prevail over all but Asiatic waters south of 30° N. Over the eastern ocean, they extend northward to about 35° N. The southwest monsoon is well established in Asiatic waters, blowing most steadily over the South China Sea. The westerlies of the middle latitudes, because of the absence of the Aleutian Low, are less steady than during the colder months. Large southerly components are found over the western two-thirds of the ocean at these latitudes, while northerly components as a rule are closer to the conterminous United States and are also observed out from the Gulf of Tehuantepec. Easterly winds prevail over the waters of the Gulf of Alaska. Wind speeds over the Pacific average slightly less than force 4.

GALES associated with extratropical cyclones are rare during July over almost all of the North Pacific, but a greater than 5-percent frequency does exist over a 2° square north of the central Aleutians.

EXTRATROPICAL CYCLONES. Cyclogenesis during the summer occurs in Asiatic waters from Taiwan northward to Sakhalin and northeastward to the Near Islands. The greatest frequency is east of Honshu and Hokkaido. Two other areas are found near 47° N. from 155° to 175° W, and over the Gulf of Alaska. The primary storm tracks lead from Honshu northeastward to the Bering Sea and from a point near 52° N, 157°W, to the Gulf of Alaska.

TROPICAL CYCLONES. Usually three or four tropical storms occur over the western North Pacific during July. Only one of these will not become a typhoon. These storms originate mostly over the ocean areas east of the Philippines. During their early stages, they generally move west-northwestward; after development, some may continue across the northern Philippine Islands into the South China Sea, while others curve northwestward toward Taiwan, the coast of mainland China, Korea, or Japan. Those reaching higher latitudes generally recurve toward the northeast under the influence of the upper westerlies.

Another area of tropical cyclone activity is over the waters off the west coast of Mexico. Around four tropical storms can be expected in July, with one reaching hurricane force. These storms are usually shorter lived but can be dangerous to both marine and coastal interests. They normally move west-northwestward out to sea, but sometimes they pass inland over Baja California.

SEA HEIGHTS of 12 ft or more may be expected about 10 percent of the time in two small areas southwest and southeast of the Aleutians near 48°N, 165° E, and near 49°N, 155°W.

VISIBILITY. Compared to other months of the year, the occurrence of low visibility over northern waters is most frequent during July. The visibility drops below 2 mi in over 40 percent of all observations over a circular area bordering the northern Kurils on the west and centered near 48°N, 158°E. The 30-percent frequency line is less circular, running from southwestern Kamchatka across the central Kurils to a point near 43°N, 160°E, and then northeastward to the Rat Islands, before swinging westward to Mys Shipunskiy. The 20-percent frequency line also crosses the central Kurils but extends farther up the west coast of Kamchatka. This line then continues southeastward from the Kurils reaching south of 40°N between 160° E and the dateline before moving east-northeastward to a point near 48°N, 145°W, and then north-northwestward to Afognak Island. The entire Bering Sea is enclosed within this 20-percent frequency line with the exception of the waters northeast of St. Lawrence Island and the waters north of a line drawn from Mys Ozernoy to Mys Navarin. The 10-percent frequency line is very similar to the 20-percent one. It stretches from the northern Sea of Okhotsk southward to the southern Kurils; it then continues southeastward to a point near 34°N, 170°E, before shooting east-northeastward to about 40°N, 140°W, and then north-northwestward to the Gulf of Alaska.

ADDRESSES OF NATIONAL WEATHER SERVICE PORT METEOROLOGICAL OFFICES

NOAA National Weather Service Port Meteorological Offices have personnel who visit ships in port to check and calibrate barometers and other meteorological instruments. In addition, port meteorologists assist masters and mates with problems regarding weather observations, preparation of weather maps, and forecasts. Meteorological manuals, forms, and some instruments are also provided.

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Figure 49.--The USCG Icebreaker SOUTHWIND leads the AMOCO WISCONSIN and the ENDERS M. VOORHEES through the ice-clogged Straits of Mackinac.

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